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THE PREVENTION OF GASTRO-ENTERITIS IN INFANTS.

By M. J. MACKERRAS and I. M. MACKERRAS,
Queensland Institute of Medical Research,
Brisbane.

STATEMENT OF THE PROBLEM.

THE gastro-enteritis in babies that we know today is the residue of the grave problem which confronted paediatricians thirty years ago. The change that has occurred in Queensland is shown in Table I, which has been compiled from Turner⁽¹⁾⁽²⁾ and from recent figures published by the Government statistician. Turner⁽¹⁾ showed further that of 167 deaths from diarrhoea and enteritis among children under two years old in 1907-1908, 124 occurred in the months from October to January, inclusive, and 43 in the rest of the fiscal year. The summer diarrhoea which then dominated the picture has practically disappeared, but the residue, represented by the 43 cases in 1907-1908, still remains. It is non-seasonal in occurrence and kills anything from 20 to 100 babies every year in this State.

It would appear that summer diarrhoea in Australia was largely dysentery;⁽³⁾⁽⁴⁾⁽⁵⁾ but the gastro-enteritis of today is undoubtedly an aggregate of several different infections, of which only two—bacillary dysentery and salmonellosis—are clearly defined and understood. Dysentery still appears to be fairly frequent in Adelaide,⁽⁶⁾ but has been uncommon during the past eighteen months among the children aged under two years in Brisbane; it is widely scattered, with some institutional bias. Salmonellosis is always present as a smouldering sporadic infection, with some clinical cases and an infant carrier rate of about 3%; infections at the endemic level are scattered in the community, but epidemics among babies are almost invariably institutional. The third, and frequently the largest, group is a mixture and is best labelled as of "uncertain aetiology". It cannot be discussed profitably at present, except to mention that

it occurs everywhere in the world, is non-seasonal and frequently (including all the neonatal cases) institutional in distribution. Campbell⁽⁷⁾ has described a typical outbreak in Melbourne.

One cannot control an organism efficiently unless one knows how it bridges the gap between host and susceptible subject. We cannot control the uncertain aetiology group; we can merely hope that protection from faecal contamination may eliminate some of its members, while protection from droplet infection may possibly reduce the number of others. We do know something of the paths of infection in dysentery and salmonellosis, and this knowledge is the basis of such effective protection as can be given against gastro-enteritis at the present day.

TABLE I.
Deaths among Infants under One Year Old.

Year.	Mortality Rate per 1,000.	Diarrhoea and Enteritis.	
		Number of Deaths.	Percentage of all Causes of Death.
1908 (Brisbane)	70.8	105	42.7
1936 (Queensland)	36.2	29	4.3
1946 (Queensland)	29.3	77	9.7

In dysentery the path is generally from the faeces of the infected individual to the susceptible subject, either by personal contamination of food or indirectly by means of flies. Older children (two to five years) in institutions probably infect each other also by direct contact; but younger babies may be infected in the same way as by the *Salmonella* infections shown in Figure I.

In endemic salmonellosis of infants the path is doubtless from a food-borne infection of an older person by direct or indirect contamination to the infant. Infections are introduced into institutions most frequently by infant

carriers, except in maternity hospitals, where the sources are the mothers (possibly sometimes the staff). Once epidemic spread begins in institutions, the sources of infection are the infected infants, and those who tend them are the vectors; the paths of infection are set out in Figure I. The points at which *Salmonellas* have actually been isolated by Mushin⁽¹⁰⁾ or ourselves⁽¹¹⁾ are printed in capital letters, so it can be seen that the story is not quite complete. It is nevertheless sufficiently clear to justify the inferences that have been drawn, pending final proof, and it has been taken as the factual basis on which the control measures described here are founded (see also Rubbo,⁽¹²⁾ Text-figure 2).



FIGURE I.
Diagram illustrating the paths of epidemic spread of *Salmonella* infections in institutions.

We would emphasize one point. We do not underestimate the importance of the food line, but we have been very impressed in watching the exploratory activities of young babies and the way that nearly everything they touch goes to their mouths. We would therefore place considerable weight on direct contamination of their clothing and surroundings as a means of transferring infection to them.

Finally, when one is developing control, one endeavours to attack the most serious part of the problem first. That is why the whole of the paper is devoted to the control of institutional infections. There will still be a residue when they are eliminated, and it can then be attacked in its turn. We are not alone in this view. Wilson and Miles⁽¹³⁾ expressed it strongly, so did Clifford⁽¹⁴⁾ and many others, and Rubbo⁽¹⁵⁾⁽¹⁶⁾ wrote his papers to direct attention to the same problem in Melbourne.¹ The description by Wilson and Miles of the position in England is so direct and to the point that it is worth quoting. They wrote:

Infantile diarrhoea is so common in institutions that no encouragement should be given to the establishment of nurseries for children under two years of age. No infant should be admitted to a hospital for treatment of any form if this can be carried out effectively at home. . . . Numbers of infants die unnecessarily every year as the result of contracting gastro-enteritis in hospitals to which they have been admitted, sometimes for relatively trivial causes. Doctors and nurses should be taught to realize that the decision to admit an infant to hospital is one that should never be taken lightly; the consequences may easily be fatal.

That such statements are necessary today is our justification for writing this paper as an expansion of an epidemiological discussion published elsewhere.⁽¹⁷⁾ There is little that is novel in the measures to be described; the authors mentioned and others have contributed to them, and the whole subject has been covered in considerable detail in War Memorandum Number 11 of the Medical Research Council.⁽¹⁸⁾ All that we have done is to add one small but useful procedure, and to emphasize those parts of the system of control which our experience indicates to be particularly important. They are worth emphasizing, because they appear to be too little known and are certainly too little applied.

METHODS OF PREVENTION.

No single method of control can be expected to banish gastro-enteritis from the wards. All methods contribute

¹ To be accurate, epidemic gastro-enteritis is not confined to institutions. It may occur wherever the density of infant population is high, sometimes in slums, recently in "bride ships", and, perhaps worst of all, in nurseries for the babies of foreign labourers on the Continent during the war.⁽¹⁹⁾ Hospitals and nurseries or homes for infants do form, however, the most permanent and accessible of the epidemic centres.

to that end and all tend to increase the efficiency of the result; they form, in fact, a system of prevention. Cromwell's maxim "neglect no means" was a favourite one of Sinton in malaria control, and it is equally applicable here.

1. Administrative Methods.

Notification.

There would be advantages in making diarrhoea of more than forty-eight hours' duration in children under two years old a notifiable disease. This would keep the disease prominently before hospital and public health administrative medical officers; it would ensure that outbreaks would be investigated promptly and efficiently by the laboratories; and it would ensure, as a result, that measures to control the outbreaks would be intelligently directed. At the least it would provide much-needed statistical data to guide future research into these important infections. There is as much need at the present day to notify the occurrence of diarrhoea in infants as that of dysentery or enteric fever in older persons.

Isolation.

There is manifestly no justification for isolating patients found at the endemic level, for many more are not found. An institutional epidemic is an entirely different matter, when the organism concerned is known, because the outside uninfected community can be protected by not discharging patients until they are "cleared" bacteriologically. The limited conditions laid down by Wilson and Miles⁽¹³⁾ as justifying isolation are, in fact, fulfilled. We have been able to demonstrate very clearly the magnitude of the convalescent carrier problem in a *Salmonella* epidemic⁽¹⁰⁾ and also to obtain evidence⁽¹⁶⁾ to support the requirement of three consecutive cultures of faeces with negative results before a patient's discharge from hospital.

2. Education.

Medical Officers.

There are two lessons which medical officers would do well to take to heart. The first is that gastro-enteritis, with onset more than twenty-four hours after admission to an institution, or less than a week after discharge, is to be regarded as a contaminative institutional infection until it is proved otherwise. That is admittedly too sweeping a generalization, but it places the onus of proof where it properly belongs. A great many *ex cathedra* statements have been made about "parenteral" diarrhoea; even the Ad Hoc Committee⁽¹⁷⁾ said: "Diarrhoea and vomiting in infancy are often due to infection outside the alimentary tract—notably the upper respiratory passages, especially the middle ears." Statements of opinion are not evidence, and in our search of the literature we have so far failed to find any that carries conviction. We have found on the other hand, for example, Findlay⁽¹⁸⁾ drawing attention to the fact that septic foci occurred both in breast-fed and in bottle-fed babies in his series, but they were associated with gastro-enteritis only in the bottle-fed. We have seen serious delay in recognizing a *Salmonella* outbreak because the diarrhoea was assumed to be associated with upper respiratory infection.

The second lesson is that in all cases in which the cause is definitely known infection enters by the mouth and the primary lesion is in the alimentary tract; the ultimate source of infection is the faeces (sometimes the urine) of another infant, an older person, or possibly an animal. *Salmonellas* have been found in the upper air passages⁽²⁰⁾ and it has been suggested that some other organisms causing enteritis may reach the gut via the respiratory tract,⁽²⁰⁾⁽²¹⁾ but the epidemiological significance of these observations is still obscure. There are abundant other reasons to control upper respiratory infections without bringing in enteritis at all. If faecal contamination is completely controlled and there still remains a residue of new infections, then a new mechanism must be sought. That there is a possibility of a different mechanism is no justification for neglecting the known pathways of infection.

These lessons may appear simple and elementary, but we state them because they are not always remembered.

Nurses.

Naturally, nurses should also be acquainted with the foregoing, and we think it highly desirable that they should be given the short course in bacteriology outlined in War Memorandum Number 11. During the war nurses became highly efficient at controlling the spread of intestinal infections, often under extremely adverse conditions. That was because they knew what they were doing, and we see no reason to believe that the same should not apply to the care of babies in civil life. There is, however, one particular lesson which they require to learn about gastro-enteritis. It is that the faeces of any baby are potentially as dangerous as those of an adult typhoid or dysentery patient. It does not matter whether they appear perfectly normal or are watery and full of mucus, they may equally contain *Salmonellas*. No woman would willingly dabble her unprotected hands in the faeces of an adult, however healthy; yet nurses and mothers do so freely in the faeces of babies. We have alluded elsewhere⁽⁹⁾ to this universal feminine superstition of the innocence of babies' faeces, but we cannot emphasize it too much, for we believe it to be the centre of the problem, and superstitions are difficult to destroy.

3. Laboratory Control.

Laboratory control may be regarded as the third of the background procedures, designed to ensure awareness of what is happening and efficiency in meeting the situations that will arise. Ideally, the faeces of every baby should be examined on its admission to hospital, and the staff should be checked periodically for the occurrence of carriers. That may not be practicable in many hospitals at the present time, but we would urge that full use be made of the laboratories to attempt to diagnose every case of enteritis or suspected enteritis that occurs. Clinicians should not lose faith in the laboratory because "no pathogens" may be the most frequent report they will normally receive; the proportion of *Salmonellas* and *Shigellas* identified will more than compensate for the apparent waste of time, for it will immediately define controllable danger points. Rather should they help the laboratories by ensuring that specimens are sent forward fresh and in good condition for examination and that not less than three specimens are examined in every suspected case.

4. Ward Management.

There are numerous instances of infection spreading from ward to ward, and the general conclusion is that it is spread by nursing or medical staff (see, for example, Rubbo⁽¹⁰⁾). Our evidence would place particular weight on unconscious contamination of the hands, so we attach great importance to the following measures.

Staff Changes.

Tours of duty in gastro-enteritis wards should be made as long and unbroken as efficiency of service and training will permit. When changes of staff are to be made, the dangers of spreading infection to other wards should be given weighty consideration in every instance. Staff relieving in gastro-enteritis wards should not be drawn from and should never return directly to wards in which other babies under two years old are being treated. Nurses who have served in gastro-enteritis wards should under no circumstances be permitted to work in maternity hospitals within, say, one month,¹ and until their faeces have been examined bacteriologically.

These rules undoubtedly make the management of nursing staffs more complicated, but it is better that management should be complicated than that infection be spread.

Duty Rosters.

It is generally recognized that "change-up" nurses should not prepare or give food (for example, Nabarro and Signy⁽²²⁾); but the arrangement tends to break down, especially at night, during periods of under-staffing. To

¹ Most infections of adults appear to be transitory, but a margin of safety is desirable.

allow it to break down under any circumstances initiates a vicious circle of spreading infection and increases the burden of an already overloaded staff.

Barrier Nursing.

Effective distribution of medical hazards and efficient barrier nursing are not strictly dependent on, but are greatly facilitated by, subdivision of the hospital into small units. "To satisfy present-day requirements, nearly half the number of beds in a children's or infectious diseases hospital should be in individual cells and the remainder in small units."⁽¹⁵⁾ Barrier nursing may be difficult to institute, when the design of the hospital does not favour it, and it may delay the nurses in their work and the medical officers on their rounds until the drill becomes an established smooth routine; but again no plea of inconvenience can be held to condone failure to prevent spread of infection. The essentials of barrier nursing are clearly set out in War Memorandum Number 11 and are quoted below as an appendix, because few copies of this invaluable publication seem to be available in Australia.

5. Ward Hygiene.

The paths of infection indicated above (Figure I) and the isolation of *Salmonellas* from sinks, scrubbing brushes, ward wash-hand basins, nail-brushes⁽⁶⁾ and hand-towels⁽⁶⁾ are sufficient warning of the importance of careful ward hygiene. Nabarro and Signy,⁽²²⁾ writing of dysentery, put the matter succinctly:

It is obvious that if a child passes as many as ten stools in a day, and is handled by three or four nurses, the chances of spreading the infection are greatly multiplied.

We know⁽⁹⁾ that *Salmonella* infections frequently enter unsuspected into wards, even in inter-epidemic periods, and it is probable that other intestinal infections enter too. It is therefore clear that the measures to block the spread of contaminative infections should be a normal permanent routine for all infant patients and not regarded merely as a temporary expedient to meet an emergency. They provide the only way by which sporadic endemic cases can be prevented from initiating outbreaks, and it would seem to be purely a matter of chance whether, once begun, an outbreak remains localized, as in Melbourne, or develops into a virulent epidemic, as in Brisbane.

The measures to be outlined are the basic minimum of sanitary protection that is necessary, irrespective of whether full barrier nursing is also practised or not.

Infant Toilet.

Removal of soiled napkins (and also soiled clothing and bedding) should be treated in the same way as removal of a soiled dressing. Gloves should be worn¹ and the nurse should be alert to handle the napkin as little as possible and to avoid contaminating herself either from the soiled part of the napkin or while cleansing the buttocks. Some contamination is often unavoidable, but a great deal of unnecessary fouling has occurred in the past, simply because nurses have been unaware how dangerous to other babies is the material they have been handling; it can be kept at a relatively low level by simple care once the risks are understood.

Disposal of Soiled Napkins (and Clothing).

Soiled napkins and clothing "should be placed directly into a sanitary bin containing diluted 'white fluid' and should not be further handled in the ward."⁽¹⁵⁾ That is satisfactory if the hospital laundry has foul-washing facilities. The bin or pail should have a tightly fitting lid and the disinfectant simply serves as an additional cover and protection for the contaminated materials; it is not to be relied on to destroy organisms in unemulsified faeces. Miss V. M. Pask in this laboratory took a specimen of faeces containing *Salmonella typhi-murium* and covered

¹ Even if supplies will not permit the wearing of fresh sterile gloves for every case, gloves are still useful because they can be washed in disinfectant between patients more efficiently than bare hands.

it with 1:100 "Zephiran" solution; after five hours' immersion of the specimen she grew *Salmonella typhi-murium* again from it.

If foul-washing facilities are not available, as in the home or in small hospitals, the napkins should be boiled thoroughly before being washed. Provided there is enough water for the napkins to swirl about freely in the boiler, and some soap powder or other convenient detergent is used, there is no difficulty with smell or stain. The faeces become emulsified and subsequent washing is made easier. Theoretical objections were raised, but the method has been proved practicable both in institutions and by individual mothers. Under these conditions very brief boiling is sufficient, but even ten minutes is not enough to ensure penetration of the faecal masses by moist heat when several napkins are piled into the boiler together. We therefore recommended twenty minutes as a minimum in institutions.

Washing Facilities.

We have already stressed that "change-up" nurses should never undertake the duties of "clean" nurses. We would stress just as strongly that "change-up" nurses should have completely separate washing facilities. If they do not, the "clean" nurses and the doctors on their rounds run a serious risk of contamination and they will be quite unconscious of the fact. Indeed the more careful they are to scrub thoroughly with the common nail-brush, the more likely are they to contaminate themselves.

It follows from the bacteriological findings that all ward nail-brushes should be boiled at least once a day and kept, when not in use, in a vessel of disinfectant which is changed daily. Paper towelling, which is used only once and then discarded, as recommended by Rubbo,⁽¹⁰⁾ should be installed in all wards.

General.

There are many minor matters worth attention, such as laying a fresh clean napkin on the scales for every baby that is weighed, care in sterilizing babies' baths, watchfulness that toys do not go from bed to bed without being sterilized, and a dozen other details, which only a careful sister can control. Not the least is that meticulous care should be shown by doctors and students that they do not break the rules which are enforced on nurses.

6. Dust Control.

Mushin⁽⁹⁾ found *Salmonella derby* in ward dust. We failed in Brisbane, but the beneficial effects of a "spring cleaning" suggest that dust may not have been completely innocent there also. There are, of course, other valid reasons to control dust, and the whole subject has been fully discussed by Rubbo;⁽¹⁰⁾ we need not enter into details here.

7. Food Preparation and Administration.

With the risks of contamination from dust and vermin and even from "clean" nurses clearly demonstrated there is every reason to condemn storing and transporting babies' feeds in open containers, and there is corresponding virtue in the American system described by Chapple.⁽²⁰⁾ The "formula room", where the feeds are prepared, is shut off by glass panelling from the outside, and staffed by specially trained nurses who work aseptically. It is divided by a glass-panelled partition into two separate parts and is provided with an elongated sterilizer, which is the only connexion between them. Bottles, nipples and caps are brought into the "dirty" end, washed, and placed in the sterilizer. In the "clean" end, mixtures are prepared, bottles withdrawn from the sterilizer, filled, fitted with nipples and covered with caps like those illustrated by Rubbo.⁽²⁰⁾ They are then sterilized again as complete units and sent out to the wards, where they are stored in refrigerators until required. Cummings⁽²⁰⁾ recommends autoclaving the units for eight minutes at 121° C., which was found by bacteriological tests to be adequate. Materials which cannot be heated may be added aseptically in the "formula room" before the bottles are sent out.

In the ward the nurse prepares the baby, removes the cover from the bottle at the last moment, and gives the feed without touching the nipple at all. The only organisms which can enter the baby's stomach are those already present on its lips or fauces. This technique completely blocks the food-line as a pathway of infection, leaving only contact infection (which we believe to be important) to be blocked by the methods described under sections 4 and 5 above.

8. Vermin Control.

It has been demonstrated that cockroaches and mice become infected with *Salmonella* in the wards,^{(8) (9)} while flies are well-known disseminators of dysentery, so the desirability of controlling all these vermin is obvious. We need not go into the methods, which are fully described in available modern text-books, such as that by Stitt, Clough and Branham.⁽²⁰⁾

9. Control of Neonatal Infections.

Neonatal diarrhoea has become an increasingly significant element in infant mortality during the past fifteen years, in association with an increasing preference of women to have their babies in hospitals rather than in their homes.⁽²¹⁾ Its causes are often obscure, but the principles of control are the same as those already described. Two points are worth special mention. In the first place, entry of infection into the hospital can occur only in two ways: from the staff and from the mothers. We have more definite evidence concerning the latter⁽⁹⁾ and would regard them as the more important. The need for particular care in the toilet of the perineum during parturition and for strict cleanliness of the mother's hands and breasts thereafter is obvious, yet women in hospital are frequently not given the means to wash their hands after using a bed-pan.

Routine bacteriological examination of the faeces of all women on admission to hospital and of the staff at regular monthly intervals is recommended by Cummings⁽²²⁾ to reveal potential infectors.

The second point is that inapparent infections can occur in the newborn just as in older babies. For example, a woman had diarrhoea when she entered the maternity hospital and *Salmonella muenchen* was isolated from her faeces; four days later her baby was found to be infected and seven days later another baby in the same nursery. The infections were almost completely inapparent in both infants. In this way an infection could be widely disseminated in a nursery before its presence was even suspected. We cannot stress too strongly, therefore, the importance in the maternity hospital of strict adherence to the system of ward hygiene which we have outlined above for the older babies. If any faeces could be assumed to be innocent of pathogens, it should surely be those of a normal baby in its first week of life; yet we have proved that even they are not to be trusted. Sporadic infections will occur, derived from mothers or possibly sometimes from staff; they should never be given the opportunity to spread.

10. Research.

We stated at the outset that the only logical procedure is to deal first with the known, to detect the proven pathogens, follow them in their pathways of infection, and then devise means to block their spread. The whole of the foregoing is based on this principle. We may hope, with Clifford,⁽²³⁾ that in controlling the knowns we may control some of the unknowns also, but we cannot be certain. The place of research in this field is to attack the residue of uncertain aetiology, subdivide it into recognizable groups, and follow each through as the *Salmonellas* and dysentery bacilli have been followed. It is a difficult task and a long-term one. Immediate results are not to be expected, but it must be tackled if the control of preventable infant morbidity and mortality is to be made fully effective.

SUMMARY AND CONCLUSIONS.

We have outlined briefly the ways in which gastro-enteritis may be prevented from spreading in institutions

which care for young babies. We believe the most important to be the following:

1. Awareness of the seriousness of the problem and of the dangers presented by unrecognized infections in wards and nurseries.
2. Strict separation of the duties and scrubbing-up facilities of "clean" and "change-up" nurses; institution of "infectious disease" techniques for all (nurses, doctors, students) who enter and leave gastro-enteritis wards.
3. Careful attention to ward hygiene, and especially to the methods of changing and disposing of soiled napkins and other contaminated material. Safe methods should be in routine use in every place where infants are cared for, irrespective of whether gastro-enteritis is occurring or not.
4. Preparation of the feeds of infants in a separate, properly designed and equipped "formula room"; and sterilization of the feeds as complete covered units before they are sent to the wards.

We are convinced that the procedures described are practicable and that the development of efficient control would result in a significant reduction in the numbers of preventable deaths. Australia is proud of its low infant mortality, but nearly one in every thirty babies still dies in its first year of life. There is no cause for complacency in that and no justification to plead cost, labour or inconvenience as an excuse for perpetuating a rate which could be lowered, as it can be by attacking the problem of institutional infections.

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APPENDIX.

Rules of Isolation Nursing in Cell or Open Ward.

The following "Rules of Isolation Nursing" are taken from War Memorandum Number 11.⁽²⁵⁾

These rules comprise the technique known variously as isolation nursing, bed-isolation nursing, barrier nursing and aseptic nursing. They are intended merely as a general guide, for a hospital may find that its own scheme of rules differs in some particulars from that given here. Every hospital is advised to check over its own rules; if they are satisfactory, there is no need to confuse the staff by making alterations in established practice. The rules adopted must be followed by all members of the staff, including doctors, students, masseuses et cetera. Otherwise it is discouraging to the nurses, and may nullify the results of their arduous work.

(a) Windows and ventilators should be open as much as possible, day and night, winter and summer.

(b) Doors of cells should be kept closed whenever possible. Swing doors should be opened with foot or elbow. Handles of ordinary lock doors should be manipulated by hand. The outside handle may be regarded as clean and the inside handle as contaminated.

(c) The head of a bed should be eighteen inches from the wall. The patient should not touch wall or locker.

(d) Each patient should, as far as wartime supplies allow, have his own thermometer, pulse-glass and pencil for charting.

(e) The patient's papers and their holder should not be removed from the bed. All charting should be done with a pencil attached to the board.

(f) Nurses should work bare-armed.

(g) If by any chance a nurse's apron or dress becomes soiled by discharge, it should be changed at once.

(h) Each new patient should be received by a nurse wearing a fresh gown, which may afterwards be the nurse's gown for that patient. The blanket from the admitting room may be used as the patient's bath blanket, if not soiled, and may be kept in his locker.

(i) Two gowns, one for nurse and one for doctor, should be hung beside each isolation patient. Where possible, a third gown should be reserved for the ward-maid. Gowns are worn to protect the clothing of staff from contamination by the patient; the outside of the gowns is therefore to be regarded as contaminated and the inside as clean. Gowns should be carefully removed and hung on a stand or peg, so as to prevent contamination of the clean inside by the contaminated outside. The word "INSIDE" embroidered in red on the inside neckband of a gown serves as a useful reminder.

(j) Before a nurse attends to the patient, e.g., gives a meal, changes a napkin, hands a bedpan—or before the doctor makes an examination—she or he should don the gown reserved for that patient and wash the hands well in soap and water.

(k) After attending to the patient, the nurse or doctor should doff the gown, place it carefully on stand or peg, and again wash the hands.

(l) The hands of the nurse or doctor should be washed immediately after touching the patient, his bed, papers, thermometer or any other article used in his case, or any article in general use which has not been sterilized. After carrying used crockery, et cetera, to the kitchen or after dealing with excreta, bedpans, et cetera, the nurse should wash her hands.

(m) Instruments, such as ear syringes, specula et cetera, should be boiled after each use. In some hospitals an individual stethoscope is provided for each isolation patient. Failing this, the chest end of the stethoscope used should be rubbed over with liquor chloroxylenolis after contact with each patient.

(n) Crockery, mugs, cutlery et cetera should be washed well with hot soapy water after each use, and then be boiled for five minutes.

(o) Bedpans, chambers and urinals (after disinfection of excreta, if necessary) should be well cleansed in the sluice room. Great care should be taken to avoid splashing. Articles should then be disinfected by heat, if possible; otherwise by immersion in disinfectant.

(p) Patients on isolation nursing should not be visited by convalescent patients.

(g) So far as wartime supplies permit, the following individual equipment should be provided for each isolation patient: bed, bed-linen, blankets, chair, locker, bed-table, one or two bath-blankets, mackintosh sheet, dressing mackintosh, head-cape, soap, soap-dish, face-flannel, towels, washing bowl, tooth-mug, tooth-brush, tooth-paste, metal hair-comb, tooth-comb, bib, thermometer and vial, charts, chart-board with pencil attached, two or three lotion bowls, gauze and cotton-wool, pulse-glass, back-tray with oil, powder and ointment. For infants, a special infant bath, and a napkin disposal bin, should be provided.

THE PROBLEM OF CORONARY DISEASE.¹

By A. J. COLLINS,
Sydney.

CORONARY DISEASE has become one of the most important problems of modern life. It appears to be increasing in frequency and to be covering a wider age group. Cassidy, in the Harveian Oration (1946), stated that the deaths from coronary disease in Great Britain were in the proportions of 48 per million living in 1926, 148 in 1930, and 473 in 1939. In New South Wales death rates from heart failure have risen from 9.81 per 10,000 living in the 1924-1928 period to 25.10 in 1939 in the male sex, and from 7.65 to 18.52 per 10,000 living in the female sex. This increase in coronary disease presents a problem to all doctors, and one asks oneself in what measure is the increase due to the conditions of modern life—to hustle and bustle, to strain and worry, to over-eating, to excessive smoking or even to alcoholic excess. We are accustomed to find atherosclerosis of the coronary arteries the basic lesion in the middle-aged and old. There is some evidence, however, that congenital narrowing or ill development of the coronary system may account for at least some of the reported cases of coronary disease in the young.

Although it has been suggested that a diet rich in fat predisposes the subject to the development of atheroma, and further, that atheroma may be decreased by a reduction of the fat content of the diet, one can say that there is no satisfactory evidence yet of the influence of diet upon the incidence of this disease.

The problem of causation as yet eludes us.

We have more definite knowledge, however, of the factors concerned in the aggravation of coronary disease and of its effect upon the myocardium. The association of coronary disease with arterial hypertension is well recognized. Probably about 50% of patients with atheromatous coronary arteries also suffer from hypertensive arteriosclerosis. One feels, therefore, that the control of hypertension is in addition an important preventive and therapeutic measure in relation to coronary disease. Especially is this so when angina of effort has declared itself.

Conditions which increase the blood pressure embarrass the heart by increasing the demand upon it. Diseased coronary arteries are at times unable to supply the increased amount of blood appropriate to the occasion. It is for this reason that laborious work is dangerous to those suffering from coronary disease. Laborious work, furthermore, accelerates the progress of myocardial degeneration resulting from coronary disease, and frequently causes a breakdown when some sudden strain occurs—for example, on the lifting of heavy weights. The exact pathological basis of this breakdown is not determined. I am not at the moment referring to patients who are the victims of coronary occlusions. Many patients break down at work, who yield no cardiographic evidence of coronary occlusion, although there is evidence of coronary disease. Some of them probably are examples of acute coronary insufficiency—a condition in which acute myocardial necrosis or infarction occurs.

A considerable literature has accumulated dealing with acute coronary insufficiency. Typical examples are those

of Gross and Sternberg, who reported 15 cases of myocardial infarction in hearts in which the coronary arteries were found to have undergone little internal change and no material narrowing.

Masters and others have distinguished between the clinical and electrocardiographic changes occurring in this condition and those found in coronary artery occlusion.

Freidberg and Horn found 38 instances of myocardial infarction without coronary occlusion in 2000 autopsies.

In the last ten years acute coronary insufficiency has received wide recognition as an entity. It occurs when the blood supply of the heart becomes suddenly insufficient. This is mostly occasioned by positive lowering of intracoronary pressure, as in shock and after hæmorrhage; and cases have been reported in anæmia and aortic stenosis. As insufficiency is a relative term, it has been postulated that sudden effort by a patient with narrow coronary arteries may produce infarction. From my review of the literature and from my own experience I am not satisfied that this theory can be accepted as an established fact. There is no doubt that ischæmic hearts are seriously affected by sudden severe exercise and that irreversible changes occur in their functional efficiency. The true mechanism underlying this phenomenon has not in my opinion been satisfactorily determined.

The relationship between effort and the onset of coronary artery occlusion may now be discussed. Paterson has been writing on the subject for many years and has concluded that effort is responsible for coronary thrombosis on grounds which, in my opinion, are totally inadequate. He was one of the first to record that intramural hæmorrhages are found frequently at the level of the occlusion. Thrombosis results from consequent narrowing of the vessel's lumen or from rupture of the intima by the hæmorrhage. The existence of such hæmorrhages cannot be doubted, although their frequency appears to be higher in America than in this country.

Horn and Finkelstein analysed unselected autopsies after 100 deaths due to coronary occlusion. Intramural hæmorrhage caused the occlusion in 62.80% and thrombosis on a plaque in 37.5%. They did not accept Paterson's theory that effort produced the intramural hæmorrhage.

Masters, Dack and Jaffe have offered overwhelming evidence, based on 1440 attacks, that coronary occlusions occurred irrespective of physical activity. They held that there was no evidence that intramural hæmorrhage in coronary arteries, which is the usual forerunner of thrombosis and occlusion, was provided by physical effort or excitement. It was found frequently in patients who had been bedridden prior to the occlusion.

My own observations compel me to believe, with Masters, that these hæmorrhages are the result of disease only. This is a question of great medico-legal importance.

Let us now turn to the question of tobacco. The influence of tobacco upon coronary disease is of considerable interest to the public and to the medical profession alike. Opinion appears to be hardening against permitting the use of tobacco in coronary disease.

Bryant and Wood found electrocardiographic changes in the T waves of 16 patients who had suffered from angina and who were asked to smoke cigarettes. They concluded that the cardio-vascular effects of tobacco smoking varied greatly from person to person and in the same person from time to time. They considered it possible that tobacco was more important in causing coronary symptoms than had been thought in the past.

It has not been proved that tobacco has an effect upon the coronary vessels comparable with its unquestioned deleterious effect upon the peripheral arteries in certain diseases. The so-called tobacco angina is responsible for a sharp difference of opinion.

White, Pickering and Sanderson, Allertitt, Lewis and others attribute all such paroxysms to increased cardiac work resulting from elevation of blood pressure and heart rate, and ignore the possibility of coronary spasm. Others (Hulchard, Wilson and Johnston *et cetera*) believe that in some instances the occurrence of coronary spasm can hardly be doubted.

¹ President's address, delivered before the Section of Medicine, Australasian Medical Congress (British Medical Association), Sixth Session, Perth, August, 1948.

Wilson and Johnston studied two patients with *angina pectoris*, in whom smoking caused paroxysms and transient electrocardiographic changes similar in magnitude and kind to those of myocardial infarction. In one subject no alteration in pulse rate or blood pressure accompanied the electrocardiographic changes. There is considerable evidence that the coronary circulation is regulated by direct vasomotor control, as well as by purely mechanical factors.

In the face of all this evidence tobacco smoking should be interdicted by the physician treating coronary disease.

There is more unanimity of opinion covering the use of alcohol by patients whose coronary arteries are diseased. In moderation alcohol cannot possibly harm such patients. The belief that alcohol is beneficial, in that it dilates the coronary arteries, is possibly a chimera, in the case of patients with advanced disease. The coronary arteries in such people are incapable of material dilatation. However, excessive intake of alcohol must be harmful. It causes excitement and palpitation and thereby increases the work of the heart.

I believe that one should advise in this disease that alcohol should be taken sparingly, if at all.

Diagnosis.

As early diagnosis is so very important in this complaint I shall now discuss one symptom—namely, pain—which often appears early enough to cause alarm.

Pain is frequently an early symptom and a symptom which may be of such a nature as to declare its origin with comparative certainty. The so-called angina of effort is pain of this type. Lewis emphasized the fact that the amount of effort necessary to evoke this angina was constant for the particular patient and for the time period under consideration. This is a statement which is by no means completely true. Whilst it may be true of most patients, I have seen a few people in whom pain resulted from varying degrees of effort. Even in these cases, however, the minimum amount of effort required to produce pain was mostly consistent in extent; yet on some few occasions these patients could do more work than they were accustomed to without experiencing pain. When this variation in the effort necessary to cause angina is present early in the disease, diagnosis becomes a problem, especially in the absence of definite physical signs of organic abnormality. The clinical experience of the observer will be tried to the full. He will examine the patient's story carefully before coming to a decision. It is my firm conviction that the diagnosis of coronary disease must not be rejected because of an occasional variation in the quantity of effort needed to provoke pain. It is well known that digestion increases the work of the heart and that after meals less exercise than usual is sufficient to provoke angina in sufferers from this complaint. Angina due to coronary disease may also follow exposure to cold air or cold water and may occur when the subject is undergoing emotional stress. Some of the anomalies in the evidence of angina may be explained by emotion. Work performed hurriedly and under mental stress may provoke pain at a lower level of effort than that usually sufficient for a particular patient. In mild coronary disease pain due to emotion may be present for two or more years before effort becomes obvious as a precipitating factor. The pain which occurs at rest in patients who are well fitted for work, as well as *angina decubitus*, can be satisfactorily explained only as resulting from emotion.

The nature of the pain may next engage our consideration. Most observers have described angina of effort as being a sense of constriction or weight rather than a stabbing or cutting pain. With this I am sure we are all in agreement. When the pain is substernal it is always, I believe, of this oppressive character. However, there may be precordial discomfort, varying from slight to severe, situated frequently a little above and internal to the left nipple. The pain may radiate to the shoulders and upper limbs as the disease advances. More often this radiation is to the left side only. Less frequently it is to the right side and only sometimes to both sides.

The pain in the upper limb is mostly described as being always along the inner side of the upper limb. This observation is true for the most part. However, variation occurs and must be noted. It is true that pain radiating from the chest to the left shoulder and proceeding down the outer side of the left arm should not be regarded as due to coronary disease. However, some patients with coronary disease complain of pain within the limb, as though passing down the centre. Sometimes, instead of being painful, the limb merely feels heavy or numb or "dead". It should be remembered that radiation of pain sometimes occurs upward into the neck and to the jaw as well as downwards to the abdomen.

One of my patients who had an acute coronary occlusion two years ago has resumed playing bowls. During every game he experiences pain in one place only—the lower jaw.

The duration of pain is mostly but a few minutes in a patient who rests as soon as he is stricken. In the average patient, as the disease advances, whilst the pain may become more severe and may be more easily elicited, it still remains of the same short duration. In exceptional cases the pain may last for half an hour, in spite of rest. Towards the end of life pain becomes almost constant for a few days.

One such patient of mine, who had suffered from occlusion of a coronary artery terminal nine years previously, remained at work as a company director to within one day of his death. He had angina of effort of moderate severity. His pain became suddenly worse one week before his death, and for the last two days ceased only when he fell into a few hours' sleep. His end came abruptly, no doubt from another occlusion.

Pain and vague precordial discomfort of a premonitory nature sometimes precede an occlusion even by months. In the absence of any clinical or cardiographic evidence of coronary disease these vague premonitory pains are generally disregarded. I suggest that pain of any sort over the heart, complained of repeatedly as an isolated symptom by a middle-aged or elderly person, should be treated with great respect.

My final remark concerning coronary pain is to remind you that severe angina of effort commencing suddenly and of severe extent *ab initio* is a harbinger of impending occlusion.

Conclusion.

I have entitled my paper "The Problem of Coronary Disease". I might well have called it "The Problems of Coronary Disease", as several problems are involved. The chief of these are those of causation, control and prevention.

TREATMENT OF CORONARY DISEASE AND ITS COMPLICATIONS.¹

By J. G. SLEEMAN,
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CORONARY DISEASE, once established, pursues a steady course to end in heart failure, uninfluenced by any known forms of drug therapy.

The aim of treatment is to make the most of what useful function remains to the heart, rather than to embark on a forlorn hope of trying to improve the coronary circulation. The steady progress of the disease may be punctuated, at almost any period, by the occurrence of one or all of three episodes, which are alike in that they are manifestations of a state of acute bloodlessness of some portion of the heart muscle, but which differ in the length of time for which such ischaemia persists and in the circumstances under which it is produced. It is to the prevention and treatment of these episodes that I propose to direct your attention.

The first of these episodes is angina.

¹ Read at a meeting of the Section of Medicine, Australasian Medical Congress (British Medical Association), Sixth Session, Perth, August, 1948.

The First Episode: Angina.

Angina is the manifestation of a state of bloodlessness of the heart, which is relative and temporary. It is relative in that the supply is sufficient for the resting heart but not for the increased needs of exercise; it is temporary in that as soon as the effort that called the pain into being is stopped insufficiency becomes sufficiency again. Not every patient with coronary disease suffers from angina. The overweight, the hypertensive, the diabetic, all seem particularly vulnerable; the liability to attacks is increased by anæmia, by hyperthyroidism and by paroxysms of rapid heart action.

In the vast majority of cases the precipitating cause of the attack is effort, either by itself or undertaken in cold weather or after a heavy meal. The influence of emotion in this direction should not be forgotten.

The treatment of angina consists in eliminating the predisposing causes by appropriate treatment and by careful scrutiny of the patient's daily life, cutting out all needless activities involving efforts provocative of angina, and further, by the use of vasodilator drugs to prevent an attack of pain should certain exertions prove imperative.

Among the restrictions imposed on the patient, the one most likely to be resented is the interdiction of smoking. However, this injunction is essential, for all authorities are agreed on the vasospastic action of nicotine; it is nevertheless heartening to read that alcohol is one of the most efficient vasodilators we have. Therefore its use is to be tolerated, if not actually encouraged. It seems from this that what you lose on the swings you make up on the roundabouts.

Many drugs are used for their power of dilating blood vessels—potassium iodide, sodium nitrite, erythrol tetranitrate, nicotinic acid, theophylline and theobromine, thyroid extract—and each physician has his favourite. The following are the most potent. Papaverine is given by mouth in doses of two to four grains three or four times a day. Trinitrin ($\frac{1}{100}$ grain) for continuous use must be given frequently. Apparently it is not toxic. Levine mentions the case of a patient who took 1000 such tablets in one week with no ill effect; but let us hope with some benefit. Trinitrin is particularly valuable if given a couple of minutes before the undertaking of some unavoidable effort likely to induce an attack. As some attacks are likely to follow an emotional outburst or to be associated with a flatulent abdomen, the cultivation of an attitude of mental calm and of a collapsed intestine has much to commend it. Phenobarbital, 0.5 grain three times a day, and paraffin at night may assist materially in these matters.

During the attack the best drug is trinitrin ($\frac{1}{100}$ grain), chewed and then swallowed. Amyl nitrite is equally efficacious, but generally leaves such a thumping head in its wake that patients prefer to be without it.

There is scarcely any need to instruct the patient to desist from effort during an attack; the pain is so acute that all the patient can do is to stand still or to hang on to something until the pain eases.

It is good practice to put to bed for a few weeks a patient with recently developed angina.

The Second Episode: Acute Coronary Insufficiency.

Acute coronary insufficiency, or *angina decubitus*, like angina, is a manifestation of relative ischæmia of heart muscle, but the effort that calls it into being is so little that the pain may arise at rest. It is obvious, under these circumstances, that the margin between relative and absolute ischæmia is decreasing to vanishing point and the danger of cardiac infarction is imminent.

It is important to remember that acute coronary insufficiency may be precipitated by loss of blood from hæmorrhage, by shock or by the dehydration of any severe debilitating illness.

The remedy is to place the patient at complete rest in bed, to give rapidly acting vasodilators and to administer oxygen. Papaverine, in doses of two grains intravenously, and aminophyllin, 7.5 grains being given by the same route, are particularly useful in this condition. Oxygen is preferably given by nasal catheter, as patients are

frightened and oppressed by the use of a mask or oxygen tent. The usual percentage of oxygen is too low, and strengths of from 50% to 100% are advocated.

The Third Episode: Coronary Occlusion with Myocardial Infarction.

Coronary occlusion with myocardial infarction represents a state of total bloodlessness of heart muscle with actual necrosis of tissue. The ischæmia is absolute and permanent. The condition is a grave one, from which recovery, although the most frequent outcome, is always protracted and often incomplete. In any case, complications may ensue which increase the gravity of the condition and frequently precipitate a fatal result.

Treatment.

The first indication is the relief of pain by the intravenous administration of papaverine (1.5 grains) followed by morphine (0.25 grain) in ten minutes' time. The injection of atropine ($\frac{1}{100}$ grain) is regarded as advisable to prevent reflex vagus vasoconstriction. Papaverine has been shown experimentally to prevent the onset of generalized coronary vasoconstriction following myocardial infarction. This vasoconstriction may increase the size of the original infarct, and is in addition thought to be the factor responsible for the establishment of ventricular fibrillation with its usual fatal outcome.

Papaverine therefore should be given in all cases of severe coronary pain.

Absolute mental and physical rest is essential. Morphine, while so necessary at first, should be replaced by phenobarbital later on, when the pain has disappeared. Oxygen inhalation (50% to 100%) by nasal catheter or "B.L.B." mask (five-litre flow per minute) is always indicated.

For the first few days the patient is fed with fluids—water, coffee, milk, glucose and lemon *et cetera*. After this period he may be given cooked cereals, broth, junket, custard, jelly and boiled egg. Food is given in small quantities, stomach or bowel distension being avoided. Later still he may have the ulcer diet of brains, tripe and fish.

It is essential in treating the coronary episodes of the diabetic patient not to deplete the blood of sugar with too much insulin—it is wise to have always a trace of sugar in the urine.

The use of purgatives, always an important point with the nursing staff, depends largely on the amount of abdominal distension. In the absence of gas, a week's constipation would do no harm. Generally a dose of paraffin night and morning is sufficient. Often so much physical and mental distress is experienced in managing the bed-pan that it is preferable to allow the patient to use the commode.

It should be emphasized that the enforcement of absolute physical rest for a period of some weeks is particularly liable to favour the development of venous thromboses. To counteract this tendency it is a good plan to have the patient flex his knees and take six to eight deep breaths four or five times a day.

The length of time for which bed rest is required will obviously depend on the size of the infarction and on the presence and the nature of complications, so that no standard period can be laid down; in general six weeks are spent in bed, six weeks in getting up and a further six weeks in getting about before resuming work. Naturally these times may need modification if the gravity of the illness warrants it, and there is a tendency now, particularly in America, to shorten the period of convalescence. It must also be emphasized that the patient's future life will be on a much lower plane of physical activity, so that the development of a philosophical attitude towards the matter is to be encouraged.

Such is the plan of treatment in the simple case of cardiac infarction; there are, however, complications peculiar to the condition that call for special treatment.

1. Heart failure with congestion from loss of contractile muscle is treated in the usual fashion with digitalis and mercurial diuretics.

2. The development of anuria in the phase of low systolic blood pressure, leading if unchecked to uræmia, may call for treatment with 50 millilitres of 50% glucose in saline solution given intravenously. Should uræmia ensue, peritoneal dialysis may be called for.

3. Cardiac aneurysm cannot be prevented, nor is it amenable to drug therapy.

4. Disturbances of rhythm may take several forms. (a) Extrasystoles are not in themselves of great moment; but if frequent they are a grim reminder of the fact that the infarcted area of muscle is apt to set up any known disturbance of rhythm, so that quinidine sulphate in doses of three grains every four hours should be given as a prophylactic measure. (b) Ventricular fibrillation is incompatible with life for any length of time and is regarded as the cause of the sudden death which so frequently accompanies coronary occlusion. The advent of this condition cannot be foreseen, and for this reason quinidine sulphate (three grains three or four times a day) is useful as a prophylactic measure. (c) Auricular fibrillation if treated by digitalis is not abolished, but the ventricular response is lessened. Quinidine given prophylactically is sound treatment, and quinidine in larger doses up to 30 grains per day as a curative measure may be tried for two or three days; but if the fibrillation persists after withholding of the drug for twenty-four hours, digitalis should be used in full doses—that is, about two to two and a half grains of the powder are given in three or four days. (d) In ventricular tachycardia the prophylactic use of quinidine is recommended and larger doses may be tried curatively.

The second set of complications depends on the formation of thrombi in different places and on their possible detachment to form emboli.

It is a well-known fact that when a thrombosis occurs, either in a vein or in an artery, in one portion of the body, it is common, either simultaneously or within a short time, for multiple thrombi to form in other parts of the vascular tree, as well as for local propagation of the primary thrombus to take place. (This increased tendency to clotting has been related by Cummine and Lyons to the formation of fibrinogen B. It is also manifested by a decrease in the prothrombin time.) Multiple thrombosis occurs in a number of patients with coronary thrombosis, not only in different parts of the coronary circulation, but in the chambers of the heart and in the peripheral vessels, and it is possible that many cases of so-called pulmonary embolism are in reality examples of pulmonary thrombosis.

The importance of the blocking of pulmonary and systemic vessels by thrombus or embolus is easily appreciated; but it must be realized that mural thrombi may block the mouths of the Thebesian veins with propagation of the clot back into the venous sinuses of the heart and the production of further damage to the myocardium. All these possibilities provide cogent reasons for the use of anticoagulant drugs whenever there is evidence of a tendency to additional thromboses, if not for the purpose of preventing propagation of the primary thrombosis.

Heparin and dicoumarol are the two drugs for this purpose. Heparin acts promptly and is quickly eliminated (within four hours). However, it must at the present time be given intravenously and it is very expensive. Therefore it is used only when rapid results are wanted. Dicoumarol, on the other hand, acts only after forty-eight hours or more, and exhibits effects for three to seven days after its administration has ceased; it can be given by mouth and is relatively cheap, consequently it is the drug of choice. The indications for the use of anti-coagulant drugs are as follows: (i) the belief that prompt anti-coagulant therapy prevents the extension of the primary thrombus and the formation of mural clots; (ii) evidence of an increased tendency of the blood to clot, as shown by the appearance of fibrinogen B (Cummine and Lyons) or by a decrease in the prothrombin time. The technique for determining these factors is set out in the *Proceedings of the Urological Society of Australasia*, Number 1, 1947, and in *THE MEDICAL JOURNAL OF AUSTRALIA*,⁴¹ and the

papers of Cummine and Lyons and of Rose should be consulted for particulars. Rose⁴¹ speaks of three critical levels for prothrombin content in connexion with anti-coagulant treatment: (i) 30% of normal, above which clotting may occur; (ii) 20% of normal, the therapeutic optimum; (iii) 10% of normal, at which level spontaneous hæmorrhage may occur.

American figures (Irving Wright) are 35% as the critical level and 50% as the upper limit for therapeutic purposes. It is considered that the lower figures are necessary for the initiation of treatment and the higher American figures satisfactory for continuation.

However, all workers are agreed on the necessity for controlling dicoumarol therapy by daily estimations of prothrombin time and on the wisdom of withholding the drug from those with liver damage, impaired kidney function, blood disorders and peptic ulceration with a history of hæmorrhage. They are further agreed that a constant watch must be kept for signs of hæmorrhage, such as petechiæ in the skin or blood in the urine.

The actual details of dicoumarol administration are admirably set out by Rose (quoted previously) and are as follows. The daily amount of dicoumarol required is an individual matter which varies from patient to patient, and there are some who require surprising amounts in order that the level of prothrombin may be reduced to 20%. As a routine measure 300 milligrammes of dicoumarol are given after blood has been taken for prothrombin estimation. This should be given in the one dose and thereafter it does not seem to matter whether the daily requirements are given in divided doses or all at once. On the next day 200 milligrammes are given, but no determination of the prothrombin content is required, for the fall is never great in the first twenty-four hours. On the third and all subsequent days estimation of the prothrombin content must be made before the dose of the drug for the day is given. If the level is falling and is approaching 20%, no dicoumarol is given for that day; further dosage depends on the level twenty-four hours later. Whenever the level is 25% or greater, and especially if this figure represents a rise in the past twenty-four hours, a dose of 200 milligrammes is given and this is repeated each day so long as the level of therapeutic aim is not attained. Normally, after about ten days the level is more or less stable, and a common finding is that 200 milligrammes are required every other day. This dosage appears to prevent any rises to a level above 30% more readily than does a dosage of 100 milligrammes each day. Until one is familiar with the use of dicoumarol it appears wise to make daily estimations of prothrombin content; but once stability has been achieved estimations every other day are often adequate. It is probable that after a period of three weeks of dicoumarol therapy the maintenance of such a strict level is not essential and that levels below 50% will prevent the majority of thrombo-embolic phenomena.

The danger of dicoumarol therapy lies in the fact that if the fall in the prothrombin level of the blood is excessive and hæmorrhagic symptoms or signs appear, the restoration of a safe level is not always a simple matter, as in the case of heparin.

When an untoward reaction to dicoumarol with hæmorrhage occurs, administration of the drug should be stopped and energetic measures pursued to restore conditions to a safe level. Transfusions of fresh blood are usually valuable, especially if much blood loss has occurred. Also of much value are water-soluble preparations of vitamin K for intravenous use. When given in adequate amounts, they will raise the level of prothrombin sharply for periods of six to eight hours, after which repetition may be required. An adequate amount is 60 milligrammes given intravenously, and this dose of "Synkavit" (Roche) was found effective when used in some experimental observations. The oily preparations of vitamin K for intramuscular use are ineffective in such conditions as this.

In my experience there are no other manifestations of abnormal reaction to dicoumarol which require withholding of the drug. The prothrombin content may fall to low levels—for example, 12% of normal—without any

signs of hæmorrhage even in the urinary tract. Some workers recommend the regular microscopic examination of the urine for hæmaturia, for this may be an early indication of hæmorrhage; but even its presence does not mean that one should cease to administer the drug, but merely that one should wait until the level of prothrombin is once more above 20%. Some patients complain of mild headache or gastro-intestinal symptoms, but these are not severe and may be discounted safely in most cases.

I conclude by quoting some remarks of E. Sterling Nichol:⁽²⁾

The principal reason for using an anticoagulant in coronary thrombosis is to prevent embolic phenomena and extension of the initial thrombus or the occurrence of a second thrombus during the convalescence. Although the idea of treating with dicoumarol only if the prothrombin activity is increased may be very good, there are other variables about which nothing is known. One cannot select a patient and say: "He will have a small infarct."

Nichol's results were not outstanding, but did compare favourably with published series. In 68 attacks 11 deaths gave a mortality rate of 16%. No proved embolic phenomena occurred in the entire series. At the eight autopsies performed there were absolutely no signs of mural thrombi. Since autopsy statistics show that 50% of all myocardial infarcts produce mural thrombi, it seems rather significant that in these eight cases no mural thrombi were found. There were 38 first attacks with only one death, which certainly is a satisfactory ratio. Heparin will probably replace dicoumarol as an anticoagulant as soon as it becomes available in the Pitkin solution.

Surgical Treatment.

Finally, for the sake of completeness, some mention must be made of the surgical treatment of coronary disease and angina. The heroic operations of sewing pectoral muscle or omentum to the heart muscle remain lone surgical adventures, and the relief of anginal pain by excision of sympathetic ganglia or the injection of these structures with alcohol is too uncertain for general use.

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THE DIAGNOSIS OF ARTERIAL DISEASE OF THE LIMBS.¹

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NORMAL blood flow through the extremities may be disturbed by a wide variety of disorders of the peripheral blood vessels. In such cases symptoms of vascular insufficiency may arise, of which the commonest and most important is pain. Clinically, the state of the peripheral circulation may be determined either directly by observations on the blood vessels themselves, or indirectly by observing the thermal state and nutrition of the limb and the results of certain special tests.

Pain and Other Symptoms.

Pain in peripheral arterial disease may be intermittent or persistent.

Intermittent Pain.

The aching, constricting or cramp-like, muscular work-pain, which causes intermittent claudication, is due to ischaemia in actively contracting muscles. It follows continuous exercise of the lower limbs and is promptly relieved by rest, the intensity and duration of exercise

needed to cause pain gauging the severity of the affection. Comparable pain may occur under similar conditions in the upper limb. In the absence of severe anaemia (Pickering and Wayne⁽¹⁾) such intermittent pain specifically indicates deficient arterial blood flow to the limb.

Aching of the lower limbs in cases of varicose veins with chronic venous insufficiency may occur after prolonged standing, less after walking; it has not the characters of intermittent claudication and is attributed to congestion, with or without oedema, of dependent muscles and subcutaneous tissues. Painful nocturnal cramps in the lower limbs may sometimes disturb sleep. Moss and Herrman⁽²⁾ in a study of 20 such cases conclude that these cramps are unrelated to the intermittent claudication of arterial disease and at least in some cases are due to venous stasis and accumulation of metabolites.

Characteristic burning pain in the feet or hands may be induced by warmth or dependence in erythromelalgia (erythromelalgia).

Actual pain in episodes of Raynaud's disease is very rare.

Persistent Pain.

Sudden arterial occlusion by thrombosis or embolism may lead to severe, persistent pain in a limb. Lewis⁽³⁾ emphasizes that the pain does not arise directly as a result of the arrested circulation, but only if the muscles are active under ischaemic conditions. Thus a sense of numbness or coldness may precede the pain if the limb remains at rest after losing its circulation. The time of onset of the pain, numbness or sense of coldness in the limb is no reliable indication of the time of the arterial occlusion.

In chronic occlusive arterial disease severe, persistent pain may be associated with ulceration and gangrene. Occasionally similar pain occurs in the absence of ulceration or gangrene, the so-called "prethrophic pain", also attributed to ischaemia (Allen, Barker and Hines⁽⁴⁾).

Persistent pain, at times severe and sharp, at times dull and diffuse, may occur with ischaemic neuritis in a limb. Paroxysms of such pain may occur at night and last several hours. Roberts⁽⁵⁾ studied the involvement of *vasa nervorum* in chronic occlusive arterial disease by injection methods and sections. He concluded that ischaemia of nerves may account for persistent pain, numbness and tingling in both chronic and acute occlusive arterial disease. If the ischaemic nerve loses its conductivity the pain and paræsthesiæ disappear.

Localized pain may be present along the course of vessels subject to acute arteritis or phlebitis. Aching pain commonly accompanies phlebothrombosis and thrombophlebitis in a limb.

Colour Changes.

Skin colour is influenced by the amount of blood present and its colour, so that depth of skin colour must be distinguished from tint.

Abnormal changes of skin colour with changes in posture (excessive pallor on limb elevation, excessive redness or cyanosis on dependence) are diagnostic of occlusive arterial disease; owing to the impaired arterial circulation the pressure of the blood in the capillaries and venules is less than normal and unable adequately to overcome the effects of gravity (Fulton⁽⁶⁾); the influence of gravity on the limb circulation is thus magnified.

Pallor in Raynaud's disease or Raynaud's phenomenon is due to the capillaries and venules being empty of blood; redness is associated with vasodilatation and increased blood flow, while cyanosis results if venospasm predominates over arterial spasm (Naide and Sayen⁽⁷⁾) as the superficial capillaries and venules are then filled with cyanosed blood. These conclusions have been confirmed by direct observations on the nailfold capillaries *in vivo* (Niekau, ⁽⁸⁾ Parrisius⁽⁹⁾). The red, warm skin in erythromelalgia (erythromelalgia) during attacks is due to arteriolar and capillary dilatation.

The skin pallor immediately following sudden arterial occlusion results from the arterial spasm secondary to the occlusion (Allen, Barker, Hines⁽⁴⁾) and the blood draining into the veins (Lewis⁽³⁾); some minutes later, or longer

¹Read at a meeting of the New South Wales Branch of the British Medical Association on October 28, 1948.

(depending on the temperature), a cyanotic tint may develop and the depth of colour increases owing to the vasodilator effects of accumulated metabolites (the additional blood being derived probably from reflux via the veins). Later, purplish discoloration, due to ecchymoses, or blanched areas (Bier's spots) may appear.

Bluish discoloration of a limb, accompanied by pain and coldness, may follow extensive venous obstruction (*phlegmasia cerulea dolens* as distinct from *phlegmasia alba dolens*). This acute "blue" thrombophlebitis is rare; Haimovici and Suffness⁽¹⁰⁾ report a fourth case in the American literature and stress the clinical resemblance to acute arterial occlusion. A preceding stage of *phlegmasia alba dolens* and the presence of arterial pulsations were most useful in the clinical diagnosis.

Persistent purplish discoloration of the hands and feet may be present in acrocyanosis and a purplish mottling of the limbs in *ivedo reticularis*.

Tests Using Colour Changes.

The rate of return of colour after blanching of the skin by pressure depends on the pressure of blood in the venules communicating with those emptied, and not necessarily on the rapidity or otherwise of the circulation in the limb. Rapid obliteration of the area of blanching has no diagnostic value, for this will occur in congested skin after the circulation to the limb has been arrested. However, a slow return of colour to the area blanched by pressure indicates slowness of the local circulation, though this may be due to vasoconstriction caused by environmental cold.

Pickering⁽¹¹⁾ described a simple colour test using the principle of reactive hyperemia. The warmed limb is elevated to drain out the blood; a sphygmomanometer cuff is applied to the thigh and the femoral vessels are occluded for five (or better, ten) minutes, the limb after occlusion being kept warmed in a horizontal position. On sudden release of the tourniquet a flush should spread to the toes in two to five seconds and be maximal in about fifteen seconds. Delay occurs when the arteries are occluded. A similar test may be applied to the upper limb.

Competency of Arteries.

Arterial pulsation indicates patency of the vessel at the region palpated but does not necessarily signify normal blood flow, for there may be obstruction more distally. Nor does absence of pulsation in an artery prove absence of blood flow, as the flow may be rapid in the pulseless arteries of the legs in aneurysm or coarctation of the aorta.

Arteries may be palpated where accessible, both for pulsation and for assessment of the characters of the arterial wall (thickness, tortuosity, calcified plaques, nodules, tenderness *et cetera*). A pulsating *dorsalis pedis* artery may be absent on one side in about 12% of healthy persons, on both sides in about 7%, while one posterior tibial pulse may be absent in about 2% of healthy persons (Silverman⁽¹²⁾). Occasionally in a healthy person, a radial artery may turn dorsally higher in the forearm than usual, so that the radial pulse may be absent from its usual location.

In some cases collateral circulation may be determined by the presence of pulsating arteries in abnormal positions. An occlusive lesion of a radial or ulnar artery distal to the wrist may be demonstrated clinically by squeezing the blood from the hand and compressing one artery, when the return of colour to the hand will be delayed if the other artery is occluded by disease. A similar test may be applied to the foot (Allen, Barker and Hines⁽¹³⁾). As cold causes vessels to contract, a part, if possible, should be warm when arteries are being examined for pulsation.

When the vessels of the normal hand or foot are well dilated by warming, the skin displays capillary pulsation. This fails to develop if there is material obliteration of any artery supplying the skin under observation (Lewis⁽¹⁴⁾).

Pulsatile swellings in the extremities usually indicate aneurysms; care is sometimes necessary, however, to exclude vascular tumours.

Skin Temperature.

The temperature of the skin depends on the heat brought by the blood and the heat lost from the skin surface. If these factors are taken into account, temperature is perhaps the most reliable gauge as to the state of blood flow to the skin (Lewis⁽¹⁵⁾), increased blood flow through the skin being reflected by a rise in skin temperature, and conversely with diminished skin blood flow. The blood flow through the skin is often, but not necessarily, an indication of the blood flow through the entire extremity.

In response to moderate environmental temperature changes the temperature of the face and trunk tends to remain fairly constant, body heat being conserved or lost by vasoconstriction or vasodilatation of the extremities (represented by a fall or rise in skin temperature) (Richards⁽¹⁶⁾). The face temperature in particular tends to remain remarkably constant (Benedict and Parmenter⁽¹⁷⁾). There is normally a progressive fall in skin temperature from the trunk to the digits, the difference being greater with low environmental temperatures and less with high environmental temperatures. The feet are usually colder than the hands. When blood flow increases to a limb the fingers warm more quickly than the hands (Lewis⁽¹⁵⁾). Normally there is a striking bilateral symmetry of skin temperature (Richards⁽¹⁶⁾), and comparison of relative skin temperatures is often more important than the precise temperature reading.

The practised hand when warm will detect small differences of skin temperature; Lewis⁽¹⁵⁾ considered the dorsal surface of the middle phalanx of the flexed finger to be the best testing surface. For accurate temperature estimations and for recording purposes instrumental methods are essential. Mercury-in-glass thermometers, partly insulated so that only the surface to be placed in contact with the skin is exposed, may provide fairly accurate readings, but have many disadvantages (Richards⁽¹⁶⁾, Stewart⁽¹⁸⁾). Better results are obtainable by the use of the principle of the thermocouple so that the temperature of a skin area can be read off accurately from the deflection of a galvanometer needle over a calibrated scale. With a self-recording galvanometer it is possible to draw the thermocouple junction slowly over the skin and obtain a curve representing the skin temperatures of a number of points on the body surface (Richards⁽¹⁶⁾).

Skin temperatures may be altered by sleep, tobacco smoking (Stewart, Haskell and Brown⁽¹⁹⁾), changes in metabolic rate, position, vasomotor tone and environmental temperature, as well as by arterial disease.

Nutritional Changes.

After sudden circulatory arrest in a limb the ischaemic nerves soon lose their functions. Thus tactile, pain and thermal sensibilities are lost in that order, at first distally, the loss then spreading centripetally. Muscular weakness and then paralysis likewise spread centripetally (Lewis⁽²⁰⁾). If the period of ischaemia is short (half to one hour according to Lewis), recovery of sensory and motor functions is rapid and complete. If the period of ischaemia is more prolonged, the nutrition of the tissues may be permanently affected—necrosis of muscle, degeneration of nerves, skin wealing and blistering, and finally necrosis and gangrene.

In chronic occlusive arterial disease impaired blood supply may lead to signs of ischaemic neuritis, a thin atrophic condition of the skin, excessive skin callus over weight-bearing regions, irregular and slow nail growth, frequent local skin infections, and perhaps finally indolent skin ulceration and gangrene, which most frequently affects the distal parts of a foot or hand unless otherwise localized by trauma or sepsis.

Other Clinical Observations.

Tenderness to pressure may be found in a limb in ischaemic neuritis, or along the course of vessels subject to acute inflammatory change.

Thrills or bruits may indicate arterio-venous fistulae or aneurysms. Abnormal length of a limb may result from vascular hyperplasia or arterio-venous fistula sustained

before epiphyseal closure, while atrophy of a limb may result from impaired arterial circulation or from the inadequate use resulting therefrom.

Various manoeuvres are described in the diagnosis of thoracic outlet syndromes. General clinical examination may reveal the nature and source of a peripheral vascular lesion.

Tests of Vasodilatation and Vascular Reserve.

The degree to which ischaemia of a limb is due to vasospasm or organic arterial disease may be determined by observing the rise of skin temperature that follows abolition of vasoconstrictor tone. Such a procedure can also be used to test the integrity of vasomotor nerves and the reserve capacity for vasodilatation in a limb which is the site of organic occlusive arterial disease.

Vasoconstrictor tone in a limb may be abolished by heating the trunk or two other limbs, by local anaesthesia of peripheral nerves, by paravertebral sympathetic block, spinal anaesthesia or general anaesthesia, or by the use of drugs such as tetraethyl ammonium ("Etamon"), papaverine or sodium nitrite. Saland and Calef⁽¹⁷⁾ found that peripheral nerve block with 2% "Novocain" solution gave completely satisfactory results, dependable and unequivocal. Berry and Campbell⁽¹⁸⁾ concluded that block of autonomic ganglia with tetraethyl ammonium gave results equal or superior to other methods of producing sympathetic block (lumbar sympathetic block, spinal anaesthesia, local nerve block *et cetera*).

The maximum skin temperature obtained is more important than the amount of temperature increase (Allen, Barker and Hines⁽⁴⁾). In a limb exposed to room temperature at approximately 20° C. normal full vasodilatation will produce a skin temperature of about 32° C. or more (Lewis⁽²⁾).

Capacity for vasodilatation may also be tested by the reactive hyperemia method described by Pickering.⁽¹⁹⁾ Another simple test is to immerse the suspected limb in hot water. If fingers or toes become bright red with vivid capillary pulsation the arteries supplying these portions of skin can open widely, though simple reddening on heating is consistent with much permanent circulatory impairment.

Peripheral Arteriography.

Calcification in an artery may be visible in a plain X-ray film; this gives some information as to disease of the arterial wall, but none as to the size of the arterial lumen.

Arteriography by intraarterial injection of radio-opaque substance is almost as old as Röntgenology itself (Allen, Barker and Hines⁽⁴⁾), but there is probably no more accurate method for the study *in vivo* of the all-important arterial lumina.

Numerous substances have been employed for arteriography; "Diodrast" is in common use. Robb and Steinberg⁽¹⁰⁾ in their studies of the heart and great vessels used as a routine measure 25 to 40 millilitres of 70% solution of "Diodrast", given intravenously in 140 cases without ill effect. It is well, however, to test for individual sensitivity by a small intradermal injection of the radio-opaque substance; if the specific gravity of the urine is low or fixed, preliminary renal function tests are advisable (Kleinsasser⁽²⁰⁾). For arteriography of the limbs of the average adult, Kleinsasser⁽²⁰⁾ recommends 15 millilitres of 35% solution of "Diodrast" for the upper limb and about double this volume for the lower limb.

The radiographs must be taken at suitable instants after injection of the radio-opaque substance; this may be facilitated by temporary manual occlusion of the artery to prevent the radio-opaque medium from being swept on too rapidly by the peripheral blood-stream.

Interpretation.

A normal arteriogram reveals the smooth and uninterrupted contours of the arterial lumina, which have a direct course, while the collateral circulation is minimal (Allen, Barker and Hines⁽⁴⁾). In arterial disease there may be irregularity of contour and variations in the size of the lumen; the shadow of the radio-opaque substance

may be shaggy and moth-eaten in appearance, and all stages of narrowing up to complete obliteration of the arterial lumen may be seen. Collateral arteries are characterized by a highly tortuous course, their apparently purposeless crossing and recrossing being in contrast to the more or less direct course of the normal arteries. The site and extent of disease in the principal arteries of a limb as well as the extent and location of the collateral circulation can thus be accurately gauged. This may be useful for exact diagnosis and in determining sites for amputation. Arteriography also provides precise information regarding the extent and relationships of congenital and other anomalies of blood vessels, especially arteriovenous fistulae and aneurysms.

Kleinsasser⁽²⁰⁾ concludes that careful adherence to detail will avoid any complications of the procedure, which deserves much consideration, being easily performed and a valuable adjunct in diagnosis.

Other Special Tests.

Other special tests are numerous and in certain selected cases may yield useful information. A few will be briefly mentioned.

Cutaneous Histamine Test.

The skin is needled through a drop of 1:1000 histamine solution and a weal awaited. This normally appears within five minutes. A delayed or absent response may indicate poor prospect of healing if amputation is performed at that level (quoted by East and Bain⁽²¹⁾).

Oscillometry.

The oscillometer devised by Pachon⁽²²⁾ may be used to demonstrate changes in the volume of pulsations in the extremities. The inflatable cuff is placed upon two limbs alternately and the extent of the oscillations of the aneroid manometer compared at suitable cuff pressure on the two sides. By this means the level at which pulsations cease or abruptly diminish can sometimes be fixed more accurately than by palpation, and objective measures may be obtained in parts where pulsations are ordinarily impalpable.

Lewis⁽²⁾ and Collens and Wilensky⁽²³⁾ regard oscillometry as an occasionally valuable adjunct to clinical examination, but unessential in routine work.

The presence or absence of oscillations has a significance similar to the presence or absence of arterial pulsations in a limb, as described earlier.

Plethysmography.

A plethysmograph may be used to record changes of limb volume per unit of time, and so to calculate the actual amount of blood flowing to a limb. It probably has little value in routine clinical practice.

Other Tests.

Tests of epinephrine sensitivity and of the circulation time through a limb are reviewed by Allen, Barker and Hines,⁽⁴⁾ who conclude that they are unreliable indicators of arterial disease.

Conclusion.

Instrumental and other special investigations of arterial function are additional links in the chain of evidence which can be accumulated in a study of arterial disease of the limbs, but symptom analysis and physical examination usually provide the facts of greater importance, as with disease elsewhere in the body.

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SOME ORTHOPÆDIC ASPECTS OF PERIPHERAL VASCULAR DISEASE.¹

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THE scope of orthopaedic surgery has widened in recent years. It has become essentially a study of the locomotor system and it includes traumatic surgery. With this wider interest there has developed a greater appreciation of the importance of vascular lesions in both chronic and acute disorders of the limbs. The war not only provided a huge experiment, but showed the need for isolating traumatic conditions from general surgical cases. The treatment of damage to skin, nerves and vessels as well as bone must often be managed by the one surgeon.

The subject therefore embraces a wide field. Apart from the control of hemorrhage, both primary and secondary, and the later complications of gun-shot wounds, such as traumatic and arterio-venous aneurysms, there is the common civil problem of the management of acute circulatory failure in a fractured limb. This leads to a consideration of the delayed complications of ischaemia affecting muscles, nerves and bones, such as Volkmann's ischaemic contracture, peripheral nerve injuries and Sudeck's bone atrophy. There is also the question of the costo-clavicular syndrome, one of the interesting meeting grounds of the orthopaedic surgeon and neurosurgeon, and finally the consideration of amputation, if indicated, in

chronic occlusive vascular disease. I can hope to comment on only a few aspects of these conditions tonight.

Firstly, there is the important question of circulatory failure complicating a fracture or dislocation. Although some form of arterial injury is most commonly found associated with supracondylar fractures of the elbow, yet actual gangrene leading to amputation is much more often seen as a complication of a fractured tibia, usually in its upper third.

The patient complains of pain. The limb is pale and cold. There is absence of the normal pulse and of voluntary muscle contractions. The cause of the arterial block may be a division, contusion, thrombosis or spasm. Although it has become increasingly common in recent years to diagnose traumatic arterial spasm as the cause of such vascular accidents, it must be realized that the diagnosis cannot be made on clinical signs alone, but only when the actual lesion is examined. Many cases of spasm have now been seen and critically examined. There is no doubt that it is in fact a cause of Volkmann's ischaemic contracture, not only as the result of supracondylar fractures, but also in dislocations of the shoulder and fractures of the forearm and leg. It is the same spasm which obliterates the vessels, and so saves the lives of those whose limbs are shot off or accidentally avulsed. It may be responsible for some tourniquet accidents. It may even cause gangrene of the leg following ligation or injection of the saphenous vein. The exact nature of the condition is still uncertain—possibly a reflex vasoconstriction, possibly an inherent quality of smooth muscle in the artery. It has been shown that muscle completely deprived of its blood supply will die in approximately six hours. Other tissues, except nerve endings, are more resistant. Treatment must be commenced quickly. An attempt, but not repeated attempts, should be made to reduce the fracture or dislocation. All external pressure must be released. The limb is kept cooled and the rest of the body is heated. Plasma and blood are given when indicated and penicillin if the fracture is compound. Heparin may be added to the intravenous drip transfusion. If there is no improvement the site of obstruction should be exposed within six or eight hours. After twelve hours intervention is not indicated, and may in fact precipitate death from traumatic uræmia. It is disquieting to read in recent literature that the best treatment for a limb on which a tourniquet has been left for over six hours is amputation above the tourniquet.

At operation one may have facilities to carry out an arteriogram and so see the actual site of obstruction. One can at least free the artery, inspect it and reduce the fracture. If spasm is present one should bathe the artery in saline solution and inject procaine. This sometimes has a dramatic effect. Although arteriectomy has been performed for spasm in the upper limb with success, it is not advised unless it is obvious that the artery is also contused and the lesion is complete. Whenever possible, the fracture should be plated (this is especially important in the tibia) and so the limb is kept immobilized without the need of any external fixation. In the upper third of the tibia it is wise to be content with reduction and plating of the fracture, for any exploration of the artery here is difficult and endangers the collateral circulation. After operation, unless the circulation has been reestablished, the sympathetic should be paralysed.

Two simple principles can be stressed: (i) immobilization of the fractured limb and (ii) avoidance of external pressure. The former causes further damage to the vessels and leads to thrombosis; the latter may prevent the establishment of an early and critical collateral circulation. I can recall several cases of fractured humerus in the Middle East in which the patients were evacuated with only long arm casts and in which the arms were amputated at the base because of gangrene developing subsequently. A long arm cast, of course, does not immobilize a fractured humerus, but it does add to the embarrassment of the neuro-vascular bundle, which is helping to support the arm. Most of us have seen cases of gangrene of the lower limb associated with a fractured tibia, in which the leg has been plastered while strong traction is maintained in an attempt to reduce the fragments. Even a split plaster

¹Read at a meeting of the New South Wales Branch of the British Medical Association on October 28, 1948.

may have been an important factor in preventing full establishment of the circulation. I have also seen a very striking recovery in the case of compound fracture of the tibia with a pulseless foot, the tibia being plated and left exposed. The time factor must be stressed. To split or remove a tight plaster the day after operation should not ease the conscience of the surgeon. The damage is already done.

Where the arterial block has not been sufficient to cause actual gangrene of the limb, varying degrees of Volkmann's ischaemic contracture may occur. This is best seen in the forearm flexors following damage to the brachial artery, but minor degrees are not uncommon when recognized in the lower limbs. The main feature, of course, is a necrosis of muscle leading to fibrosis and contracture. Venous obstruction is thought to play only a small part, if any, in its causation. The peripheral nerve lesions which accompany the contracture and make the condition such a crippling one were originally thought to be due either to initial damage at the site of fracture or to constriction by the fibrosed muscle. Work at Oxford during the war, however, has shown that the nerves are also damaged from the ischaemia. The microscopic changes are quite distinct from the usual Wallerian degeneration. The gross changes can also be demonstrated at operation, as in a recent case at Royal Prince Alfred Hospital in which, on exploration, the median and ulnar nerves were found to be reduced to mere threads as they passed through the main ischaemic area, but immediately enlarged to normal size as they emerged beyond it. It has also been shown that the destruction of the main blood supply to a severed nerve may cause an irreparable ischaemic change in the distal part. In the lower limb damage to the popliteal or posterior tibial artery usually precipitates gangrene and gross contractures of the calf are rarely seen. Minor degrees, however, causing clawing of the toes, are not uncommon following fractures of the tibia and stress the need, already emphasized, for preventing constriction in plaster casts until the initial swelling has subsided.

The cause of pressure at the cervico-brachial junction is still controversial. The symptoms have for long been attributed to pressure on the subclavian artery or lowest cord of the brachial plexus from a cervical or abnormally placed first rib. Often no bony abnormality could be demonstrated. Following the work of Adson and Coffey, there has been a vogue for division of the *scalenus anterior*, but it is realized that in many cases the condition is not improved by scalenotomy, and in some it has been definitely made worse by this operation. More recently, the possibility of costo-clavicular pressure has been investigated.

The vascular lesions vary from the apparently normal state to frank thrombosis, sometimes leading to gangrene, and sometimes aneurysmal dilatations of the subclavian distal to the first rib. The cause of these is still unexplained. Even the obliteration of the pulse on bracing and dropping the shoulders, which can be noted in many normal individuals, is not easy to understand, for the pulse may still be present distal to the first rib. In some cases it has been shown to be due to constriction by the two heads of the median nerve. Telford and Mottershead, in a recent detailed review of 122 cases in which they have examined the condition at operation, stress that many factors may be involved, and the exact cause of pressure cannot be determined until the part is exposed at operation. To divide the *scalenus anterior* alone is irrational; one must be prepared to expose and remove part of the first rib, if necessary, in any case.

Finally I will make a few remarks about the management of chronic occlusive vascular conditions. The physician in charge will see that the patient has adequate rest and sleep, and that the limb is kept exposed at body level. Reflex vasodilatation is achieved most readily by placing the hands in hot water at 110° F. for twenty minutes twice a day. This method was seen in universal use in Professor Learmonth's clinic near Edinburgh during the early years of the war, and has since been widely used. Penicillin should be given to control infection and dicoumarol for thrombosis.

When the surgeon is called in, gangrene is usually established and the question of amputation arises. Gan-

grene may be confined to skin alone, or to a single toe. If a single toe only is involved, separation can often be helped surgically under cover of penicillin. When gangrene reaches the metatarsals, amputation is necessary, usually through the thigh. If one is anxious to obtain a "below-knee" amputation, one can incise deeply on the lateral aspect of the calf at operation and see if blood oozes from the muscle. If it does, one can proceed and use a long posterior flap. If there is no oozing an amputation through the mid-thigh is indicated. In America, I understand, two types are often used with which I am not familiar, but which I think offer certain advantages and should be tried here. One is an amputation through the distal ends of the shafts of the metatarsals in cases of early gangrene of the toes, or even pregangrenous conditions. The other is the Gritti-Stokes amputation (that is, an amputation through the knee, leaving the patella on the distal end of the stump), which is performed in preference to mid-thigh amputations. One thing, I think, should be kept in mind; that is, that an elderly patient is not likely to walk again with an artificial limb, whether it is a "below-knee" or "above-knee" prosthesis. Everything must be done to secure healing by first intention and so reduce their stay in hospital. For younger patients with *thromboangiitis obliterans*, however, a "below-knee" amputation is often possible, and even this is seldom necessary. In addition, sympathectomy must always be considered. To perform a lumbar sympathectomy must be considered part of the stock-in-trade of an orthopaedic surgeon. For relieving "rest" pain in pregangrenous conditions and helping in the healing of local amputations, it is often most useful; it is often disappointing when carried out for intermittent claudication, and is, of course, quite useless for established gangrene in elderly patients.

Summary.

The importance of vascular lesions complicating fractures, nerve injuries and other traumatic conditions has been discussed. The need for immobilization of fractures even by internal fixation, and for the avoidance of external pressure has been stressed. Some suggestions have been made whereby an orthopaedic surgeon can contribute to the management of both acute and chronic peripheral vascular disorders.

DIAGNOSIS OF CONGENITAL HEART DISEASE.

By CYRIL FORTUNE,
Perth.

No longer should we be content with the diagnosis of congenital heart defect without a more specific differentiation as to the nature of the defect.

Maude Abbott's clinical classification of congenital heart disease into three groups is still a very acceptable one.

The first group comprises those without abnormal communication or shunt between the right and left sides of the heart. This is usually termed the "acyanotic" group, and amongst the anomalies we enumerate: (i) simple dextrocardia, (ii) anomalies of the pericardium, (iii) primary congenital hypertrophy of the heart, (iv) pure subaortic or aortic stenosis, (v) pure mitral stenosis, (vi) coarctation of the aorta, (vii) aortic arch anomalies.

The second group embraces those with arterio-venous shunt in which the arterial blood flows into the pulmonary circulation. Cyanosis in subjects of this group is not usual, but often transient or terminal owing to the entrance of the venous blood into the left side of the heart as the pressure rises on the venous side, and therefore the descriptive term given is *cyanose tardive*. The group includes the following anomalies: (i) defects of the interauricular septum, (ii) defects of the interventricular

¹ Read at a combined meeting of the Section of Pediatrics and the Section of Surgery of the Australasian Medical Congress (British Medical Association), Sixth Session, Perth, August, 1948.

septum, (iii) defects (localized) of the aortic septum, (iv) patent *ductus arteriosus*.

In the third group are those which render the subject cyanotic. This effect is due to a large flow of venous blood into the systemic circulation, and the associated defects include the following: (i) defects of the interventricular septum with dextroposition of the aorta, (ii) tricuspid atresia with septal defects, (iii) tricuspid stenosis, (iv) transposition of arterial trunks with defects of the ventricular septum, (v) persistent *truncus arteriosus*, (vi) tetralogy of Fallot.

It is proposed to discuss only the diagnosis of those conditions amenable to surgical therapy.

In the past three years, chiefly owing to the work carried out by Bing in Baltimore and Dexter in Boston, physiological diagnostic tests have been described which supplement the clinical procedures normally used in the diagnosis of congenital heart disease, and especially are these tests necessary in complex cases in which pre-operative diagnosis is in doubt.

By the use of the intracardiac catheter, pressures of the chambers can be ascertained, gaseous analyses of the oxygen content of the blood determined, and spot films taken of the catheter with or without the use of "Diodrast" at the same time. The usual procedure is the injection of thirty millilitres of 70% "Diodrast" solution.

Patent Ductus Arteriosus.

During foetal life when blood is oxygenated in the placenta the amount of blood that circulates through the lungs is very small and the greater part of the blood in the pulmonary artery is shunted through the *ductus arteriosus* to the aorta. At birth the lungs take over the oxygenation of the blood and the *ductus arteriosus* is closed by a process similar to an obliterating endarteritis. This process ensues usually after birth, but it has been shown by Christie that in 3% of cases the duct may show signs of patency even at the end of one year. The average length of the persisting ductus is four millimetres on the long cranial side and three millimetres on the short caudal side with an average circumference of thirty millimetres.

The ductus often shows atheromatous changes and may become the site of vegetations due to bacterial infection. The patent ductus is often associated with other defects, chiefly with that of interventricular septal defect. In the past this has been emphasized more than necessary as patent *ductus arteriosus* frequently exists as an isolated lesion.

Eppinger, Burwell and Gross showed that blood flowed from the aorta to the pulmonary artery. With a large opening the volume of the leak constituted 45% to 75% of the blood expelled from the left ventricle, and therefore the blood returned to the left ventricle without going through the right ventricle. Thus the left ventricular output was two to four times that of the right. Thus there is evidence that excessive filling with overworking of the left ventricle probably explains the primary occurrence of left ventricular failure when this occurs.

Bullock's results show that 50% of affected persons die before the thirtieth year and 71% before the fortieth. The cause of death is bacterial endocarditis or congestive cardiac failure or sudden cardiac failure.

The diagnosis of uncomplicated patency of *ductus arteriosus* is usually easy and is based primarily on the typical machinery murmur. This is a harsh rumbling murmur best heard in the first and second left intercostal spaces and is practically continuous throughout systole and diastole; a thrill is usually palpable in this area.

Mannheimer states that the continuous murmur of patent *ductus arteriosus* is phonocardiographically characterized by its typical position in the pulse period and great force within the lower range of frequency and also by its maximum intensity over the left second intercostal space close to the sternum.

In what other conditions do continuous murmurs exist?

There are five other possibilities, but none of them are associated with a continuous murmur situated in the second left intercostal space.

1. Paul White states that there may be a continuous murmur in the neck of normal patients due to venous efflux to the jugular bulb.

2. Arterio-venous anastomosis of vessels in the neck may be a cause.

3. Thyroid enlargement sometimes produces a murmur.

4. A rare congenital heart affection consisting of a congenital arterio-venous aneurysm produces a continuous murmur maximum over the aortic orifice to the right of the sternum.

5. Persistent *truncus arteriosus communis* produces a murmur.

The second question we ask ourselves is: Can a patent *ductus arteriosus* exist without a continuous murmur?

Shapiro has seen only one case with a systolic murmur; the subject was aged two years and had all the other features of a patent ductus. He says: "No patient who reveals only a systolic murmur should be submitted to operation as a prophylactic measure."

Therefore in diagnosis we seek first to hear the all-important harsh rumbling murmur which is best heard in the second left intercostal space and is continuous through systole and diastole. A thrill is usually palpable. High pulse pressure is found in 50% of the cases if the ductus is of a large calibre. The electrocardiogram is invariably normal, which would be expected in an extracardiac anomaly, and if strain does occur it is usually bilateral.

The radiological picture may be normal or it may show increased left ventricular enlargement with a bulging of the pulmonary arc and with central pulmonary congestion and sometimes a hilar dance on fluoroscopic examination. An angiogram would show a small sacculum or out-pouching of the aorta at the level of the ductus.

It must be noted that there is no cyanosis in cases of patent *ductus arteriosus*. The shunt is from the aorta to the pulmonary artery, and oxygenated blood is carried a second time through the lungs. The patient may be slightly underweight and tire somewhat easily, but he nevertheless is usually a lively and energetic person up to the point of his tolerance.

The differential diagnosis should not be difficult if reliance is made principally on localization of the continuous murmur, and a phonocardiogram will certainly confirm the finding of this clinical sign.

Two conditions may be confusing, namely, the rare condition of congenital dilatation of the pulmonary artery and that of aortic septal defect.

The individual with an open ductus faces an uncertain future. If the fistula is small he may have a relatively long life without incapacitation, but there are three main hazards: firstly, the shunt may decrease the flow to the peripheral circulation; secondly, the shunt may be so large that with the increased cardiac output the heart may even fail; thirdly, in 25% of cases subacute bacterial endocarditis may supervene. The last two hazards usually occur in the third or fourth decade. Those subjects who reach the age of seventeen years on an average live twenty-five years less than a normal patient, which agrees with Bullock's estimate that 70% of these patients die before the age of forty years.

At first the operation was reserved for those who were in a state of cardiac failure or had supervening infection of the ductus. But it must be obvious that even at the age of four or five years the heart is subject to an excessive burden, and so the present trend is in the direction that all affected patients should undergo the operation.

Coarctation of the Aorta.

Coarctation of the aorta passes unrecognized unless the possibility is borne in mind and especially if it is associated with patent ductus or aortic incompetence.

The knowledge that the hypertensive under thirty years of age may be suffering from coarctation of the aorta and the easy recognition by the radiologist in routine chest work of notching of the ribs may lead to earlier diagnosis of this condition.

Its incidence is usually one in one thousand individuals. Various anatomical classifications have been proposed.

Usually it is customary to consider two types. In the first, the infantile type, it is found that there is a diffuse

narrowing of the aortic isthmus. This is usually a serious condition associated with other anomalies and a child afflicted invariably dies in infancy. In the second type, the adult type, the narrowing of the aorta is more abrupt, as if a ligature had been tied round the aorta, and particularly is this evidenced near to the entrance of the *ductus arteriosus*. The constriction results in increase in the blood pressure in the arms and head, and the blood reaches the lower limbs only through the development of collateral vessels. Consequently the blood pressure is much lower in the lower limbs.

On the other hand, owing to the fact that sometimes with coarctation the *ductus arteriosus* may remain patent, this condition can be grouped into cases in which coarctation is associated either with a patent *ductus* or with a closed *ductus*. If the *ductus* is open there is no notching and no collateral circulation.

There may be no symptoms of ill health, the condition being detected in a routine check-up. On the other hand a migrainous type of headache may indicate the presence of a cerebral aneurysm, a frequently associated lesion, or there may be an associated aortic valvular defect with free incompetence which may produce cardiac symptoms of dyspnoea, palpitation and fatigue. On the other hand collateral blood vessels may cause pressure on nerves with resulting pain along their distribution.

The clinical diagnosis is based on certain cardinal features.

1. High arterial pressure in the upper limbs (usually higher in the right arm than in the left) associated with a lower pressure in the lower limbs. The average blood pressure in the arms may be about 200 millimetres of mercury (systolic) and 105 millimetres (diastolic) with a pressure of 130 millimetres of mercury (systolic) and 80 millimetres (diastolic) in the legs.

2. Feeble or absent pulsation in the femoral artery and the abdominal aorta.

3. Pulsating arteries found in the back or front of the chest. Maurice Campbell has recently drawn attention to a new physical sign.

Inspect the surface of the back from all angles and in good light. Palpate lightly over the chest, front and back. Now ask the patient to bend forward with the arms hanging down and pulsation of some of the collateral blood vessels will be more clearly visible.

This is due to the widening of the costo-clavicular space with lessened constriction to the dilated subclavian artery.

4. Forceful arterial pulsation in the root of the neck (similar to that seen in aortic incompetence).

5. Late systolic murmur best heard to the left of the sternum in the second and third intercostal spaces and sometimes in the interscapular region. This is present in 22% of cases and is considered to be due to an associated bicuspid aortic valve. Sometimes there is an accompanying thrill.

6. Diastolic murmur at the aortic area, which is often found.

Usually the diastolic pressure is high in coarctation unless there are congenital or infective changes in the aortic valve cusps.

Here are three simple rules to aid in the clinical diagnosis: (i) if a raised blood pressure is unexplained in a young person suspect coarctation; (ii) if a patent *ductus* is diagnosed take the blood pressure in the legs; (iii) if aortic incompetence is found take the blood pressure in the legs.

The electrocardiogram is not diagnostic as to axis or other features.

Radiological Manifestations.

Rib notching is visible in the X-ray films in the majority of cases and usually it is first seen from the age of seven to eight years. This is not present if the *ductus arteriosus* is patent.

An occasional double prominence in the region of the aortic knuckle is found—the upper component representing the dilated left subclavian artery from the "blind" end of the aorta proximal to the coarctation, and the lower component the "blind" end of the descending aorta.

Absence of the aortic knuckle is sometimes described.

An angiocardigram may show distinctly the lower end of the coarcted aorta, but normally in routine fluoroscopic examination coarctation is rarely seen.

Any enlargement in the size of the heart is not due to the high blood pressure, but is due to the added anomalies of congenital aortic valvular defect with the subsequent free incompetence.

Prognosis and Treatment.

It is during the years from six to sixteen that the blood pressure gradually increases, the collateral blood vessels develop and notching of the ribs occurs. In this period the walls of the aorta are still soft and no gross atheromatous changes have taken place. Therefore it will be during this period that surgical excision of the coarcted portion of the aorta will be less difficult.

Anomalies of the Aortic Arch.

Various developmental abnormalities of the aortic arch and great vessels may give rise to clinical symptoms of pressure on oesophagus or trachea.

The types of anomalies are: (i) right-sided aortic arch, (ii) double aortic arch, (iii) anomalous right subclavian artery, (iv) anomalous left subclavian artery.

These anomalies in some instances in infants produce rather a characteristic clinical picture.

Stridorous breathing, mainly inspiratory and worse with feeding or emotional upsets, may be an early sign. Liquids are tolerated fairly well, but vomiting is frequent, occurring immediately after meals. When the infant begins to eat solids difficulty in swallowing may arise. A chronic metallic cough associated with bouts of respiratory infection (tracheo-bronchitis) may be a common symptom.

An oesophogram readily shows the constriction in the oesophagus and a bronchogram shows a narrowing in the trachea. Both antero-posterior and lateral pictures should be taken.

Radiological findings will depend on the type of anomaly. With a double aortic arch the posterior portion passes behind the trachea and oesophagus with constriction of both oesophagus and trachea by a vascular ring.

Tetralogy of Fallot.

The most frequent abnormality of the cyanotic group of congenital cardiac defects is the tetralogy of Fallot. In this condition cyanosis is related principally to the lack of circulation to the lungs due to the stenosed valvular orifice or approach, and therefore the treatment devised by Blalock and Taussig is to increase the circulation to the lungs by creating an arterio-venous fistula between the aorta and the pulmonary artery, or more recently by Brock's attempt to open up the stenosed pulmonary valve. In addition to pulmonary stenosis there is a ventricular septal defect, overriding of the aorta and right ventricular hypertrophy. This condition is typically illustrated by a child, five to ten years of age, who is cyanotic, displays the secondary manifestations of cyanosis, namely, clubbing and polycythemia, and experiences dyspnoea on mild exertion, and in whom a systolic murmur can be heard. The X-ray picture will show a boot-shaped heart and the electrocardiogram shows a pronounced right axis shift. But, of course, the picture is not always typical, and difficulties arise in diagnosis because there are gradations in degree of pulmonary stenosis.

The clinical features are well defined. The cyanosis has been recognized at birth or early in infancy. It varies according to the degree of anoxemia and polycythemia, and is subject to change from day to day and to vagaries of cold and warmth.

The diagnosis will depend on the severity of pulmonary stenosis, the extent of collateral circulation to the lungs and the amount of effort the child makes in his own environment. If distressed the child will adopt a "squatting position", and this sign is considered by Taussig a very significant feature. Feeding problems may be present, and poor nutrition is an associated accompaniment. Walking is delayed.

Examination confirms the presence of cyanosis, and clubbing of the terminal phalanges of fingers and toes

will be noted. Suffusion of conjunctivæ is apparent, and large tortuous vessels will be seen in the eye grounds if polycythæmia is well marked. Left-sided chest deformity may be obvious due to right ventricular hypertrophy.

The systolic murmur is proportional to the degree of stenosis (Brock) and usually heard maximal in the third or fourth left intercostal space and transmitted posteriorly. It may be accompanied by a thrill. The blood pressure is difficult to ascertain, and the second pulmonary heart sound may be soft or sometimes absent.

The radiological diagnosis is very important. The presence of pulmonary stenosis means that the prominence formed by the *conus arteriosus* and pulmonary artery will be absent, and therefore there will be a concavity in this segment of the cardiac contour best seen in the right anterior oblique film. If there is only a relative degree of stenosis the concavity may not be so definite.

The pulmonary vessels, owing to decreased circulation to the lungs, will at the hilar region be found to be small with no expansile pulsation visible on fluoroscopy, and in the left anterior oblique position the aortic window will be found to be abnormally clear.

Fine vascular markings may be seen throughout the lung fields, but no pulmonary congestion. If this is present the Eisenmenger complex or transposition of the great vessels should be suspected.

The size of the heart is usually normal, but the apex is upturned in the antero-posterior view and blunt due to hypertrophy of the right ventricle. This gives a cardiac silhouette known as "*cœur en sabot*".

A right-sided aortic arch is present in 25% of cases as demonstrated in the esophogram. Whether the aorta is on the right or left is important to the surgeon. In the Blalock operation the chest is entered on the side opposite the arch.

The electrocardiogram invariably shows a right axis shift of moderate to great degree. High pointed P waves are often present, and sometimes associated conduction defects are noted.

Blood studies will reveal that the hæmoglobin value is usually about 20 grammes *per centum* with a red cell count of seven to eight million cells per cubic millimetre. The hæmatocrit reading is increased. Arterial oxygen content is low, capacity is high and saturation is low.

Catheter studies have aided considerably in the diagnosis of difficult cases.

Bing, of the Johns Hopkins Hospital, has shown the value of physiological diagnostic tests in this condition.

The catheter is passed into the brachial vein, then through into the right auricle, passing to the right ventricle and even into the stenosed pulmonary artery. Pressures of the various chambers are recorded and samples of blood are taken; its oxygen content is determined and compared with the oxygen content of arterial blood taken from the radial or femoral artery. The total pulmonary blood flow is measured, and this gives some measure of the extent of the collateral circulation. A standard exercise test is performed—stepping up to a 20-centimetre step thirty times a minute. A normal person uses more oxygen per litre of ventilation, but in pulmonary stenosis the ratio of oxygen use falls owing to obstruction. By means of an oximeter attached to the ear the oxygen saturation of blood in the peripheral arteries is measured.

Dexter has used the catheter principally to explore the anatomical defects present, to estimate the pressures in the chambers of the heart and to confirm with "spot" films the movement of the catheter throughout the heart chambers.

"Diodrast" can be injected into the catheter, and so the stenosed pulmonary artery can be visualized. The usual pressure in the pulmonary artery is 280 millimetres of water, but if it reaches 320 millimetres the operation if carried out will be unsuccessful.

The main objective in surgical treatment is to increase the pulmonary flow, and therefore it is necessary to exclude children who are cyanotic and yet have a normal pulmonary blood flow.

After exclusion of complicated defects in which death is caused in the first two years, the majority of surviving

cyanotic children have the tetralogy of Fallot except for a few who may have one of the following four defects.

1. Eisenmenger complex. This condition differs from the tetralogy of Fallot in so much as we have a dilated pulmonary artery instead of a narrowed pulmonary artery; consequently cyanosis is less intense and later in onset. The main differentiating features are normal physique, less cyanosis, a clear loud pulmonary second sound and radiologically exaggerated pulmonary conus with pulmonary vascular congestion. Angiocardiography will show a dilated pulmonary artery, and physiological studies will show adequacy of pulmonary blood flow.

2. Persistent *truncus arteriosus*. This is a large single vessel arising from both ventricles. The blood supply to the lungs is by small pulmonary arteries branching off from this vessel or by bronchial arteries. It is rare to find a lesion persisting to late childhood. In the left anterior oblique view the right ventricle extends out to the chest wall like a sheet.

3. Complete transposition of the great vessels. This requires compensating mechanism, such as septal defects or patent ductus, to maintain a functioning heart. Cyanosis is present. The heart becomes large and globular, especially on the right side.

4. Complete septal defects. Interauricular septal defect may be absent; usually there is no cyanosis until terminal failure occurs. Complete interventricular septal defect produces cyanosis; the heart is enlarged, especially on the right side; an electrocardiogram shows a large biphasic QRS complex in all leads.

Stenosis of the tricuspid valve is a rare anomaly usually with septal defect. Cyanosis is present. Radiological views show enlargement of the auricles and left ventricle and a small right ventricle. Left axis deviation is present in the electrocardiogram.

Conclusion.

The diagnosis of congenital heart defect in complex cases requires the concerted efforts of a team of workers—physiologist, biochemist, physician and radiologist. The advances in the last few years in the diagnosis and cure of these defects have been stimulated by the magnificent progress made by surgeons in the field of thoracic surgery in the last decade.

SURGICAL TREATMENT OF CONGENITAL HEART DISEASE.¹

By C. J. OFFICER BROWN,
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As recently as 1937 White stated that there was no curative treatment, medical or surgical, for congenital cardiac defects. Since that time surgical methods for the treatment of three separate types of congenital cardiac defects have been introduced, and there is no limit to the possibility of future developments. The three groups suitable for surgical treatment are: coarctation of the aorta, patent *ductus arteriosus* and pulmonary stenosis or atresia. It is of interest to note that of these three conditions one falls into each of the three groups described by Maude Abbott in her clinical classification of congenital heart defects. Coarctation falls into the "acyanotic" group and patients with an uncomplicated coarctation are never cyanosed, except, of course, in the terminal stages of cardiac failure. Patent *ductus arteriosus* falls into Maude Abbott's second group, which includes patients with arterio-venous shunts which allow arterial blood to enter the pulmonary circulation. These patients are not normally blue, but may become cyanosed as a result of terminal or transient reversal of blood flow through the shunt. The third group includes those patients in whom cyanosis is a feature, who have a shunt which

¹ Read at a combined meeting of the Section of Pædiatrics and the Section of Surgery, Australasian Medical Congress (British Medical Association), Sixth Session, Perth, August, 1948.

allows large quantities of venous blood to enter the arterial circulation. Patients with the tetralogy of Fallot fall within this group.

Patent Ductus Arteriosus.

Patients with a patent *ductus arteriosus* may live a normal life and die of ripe old age, but there is evidence that many of them die young as a result of the complications of their condition. Eppinger, Burwell and Gross demonstrated that 45% to 75% of the blood expelled by the left ventricle escaped through the patent *ductus arteriosus* and was returned to the left auricle; in consequence of this the output of the left ventricle was two to four times that of the right. Keys found that the leak constituted from 20% to 70% of the left ventricular output. These figures have been estimated at operation, and it is probable that the leak in many cases is considerably less than this, but it is not surprising that the left ventricle tends to break down in some of these cases. Subacute bacterial endocarditis is a frequent complication of all congenital heart defects, and rupture of an aneurysm of the ductus is another not uncommon cause of death. Although the life story of patients with patent *ductus arteriosus* has not been sufficiently worked out to enable an accurate prognosis to be made for any individual patient, it seems certain that these risks mentioned constitute a much greater hazard to the patient than that of having the ductus surgically closed, and it is fair to assume that, if closure is carried out in early life, the heart will become in every way a normal organ.

In 1907 Munroe described a procedure for closure of a patent *ductus arteriosus*, and in 1938 Strieder reported an unsuccessful attempt to carry out the operation. In the same year Gross and Hubbard reported the first successful closure, and in 1940 Dolley and Jones reported a short series of successful cases. At first subacute bacterial endocarditis was considered a contraindication to operation, but in 1940 Touroff advanced the view that this complication was an urgent indication for closure of the ductus and reported four cases in which he had operated. Two of the patients died of hæmorrhage on the operating table and one of them died thirty-two weeks later of persisting endocarditis; the fourth patient was cured. Two years later he reported four more successful cases, and infective endocarditis has become one of the recognized indications for operation. When Touroff tackled this problem subacute bacterial endocarditis was an almost hopeless condition. Since then intensive penicillin treatment has considerably improved the prognosis. The inflamed and friable ductus is easily torn and its closure is hazardous and, although I still believe that bacterial endocarditis is an urgent indication for ligation, penicillin should be tried first; if the infection is controlled, ligation can be delayed for some weeks until the inflammatory process in the ductus has subsided and its wall has become less friable. Before the introduction of penicillin, ligation was successful so long as the vegetations had not spread along the ductus to the aortic side. Usually the process starts on the wall of the pulmonary artery, where the stream from the ductus impinges, and spreads along the endothelium of the tube to the aortic end; it may involve the aortic valves. Systemic infarction cannot occur until the aortic side of the ductus has been infected, and its occurrence indicates that ligation alone is not likely to cure the patient.

Because of the risks associated with the possession of a patent *ductus arteriosus*, I believe that every patent ductus recognized in childhood should be closed; if the child is completely fit I would perform the operations when the child is between the ages of about six and eight years. Retardation of growth, infective endocarditis and signs of approaching cardiac failure are urgent indications for operation at any age when the diagnosis has been confidently made. Although quite a lot of the children appear to be normally developed and active, they will usually be found to compare unfavourably with other members of the family, and it is astonishing to see how even the apparently well-developed and normally active children improve after the ductus has been closed. If the patient

has reached adult life and is completely asymptomatic the necessity for closure may be disputed, and at the present time I am uncertain of the attitude one should adopt. The presence of symptoms attributable to the ductus is of course an indication for operation in adult life, and some years ago I saw two patients, one in his late twenties and the other in his late forties, with enormous hearts and very little cardiac reserve, who might have been saved by earlier operations. At the time I saw them I was afraid to interfere, but now would feel that the risk should be accepted as their only chance of survival.

Originally closure was achieved with heavy ligatures of silk or umbilical tape, and some surgeons supplemented these ligatures with a "Cellophane" wrapping which was supposed to cause fibrosis and to increase the certainty of permanent closure. In 1944, because of the frequency of recurrence following these methods, Gross introduced a technique for the division of the ductus with suture of the openings in the pulmonary artery and the aorta. In 1946 Gross and Jones reported their results. Gross had operated on 133 patients and Jones on 61. Of the combined series, 96 patients had been treated by ligation of the ductus; there were three deaths and recurrence took place in 20% of the cases. Half the recurrences were immediate, and the murmur failed to disappear or reappeared shortly after operation. In the remaining 10%, although the murmur disappeared after operation, it reappeared some months later, suggesting that the ductus had reopened. In the remaining 98 cases the ductus was divided and sutured after the technique introduced by Gross. In this group there were also three deaths and there were no recurrences.

Thirty-three operations have been performed at the Alfred Hospital with one death from hæmorrhage. In five cases no ductus was found; in four of these the murmur was not quite characteristic, but we elected to explore the heart. In the fifth case we felt that no other diagnosis could be entertained. No ductus was found and it is probable that this child has an opening through its pulmonary aortic septum. In 27 cases the ductus was occluded, and in one case the ductus was divided and sutured after the method of Gross. In one case, although the ductus was found and occluded, it was noticed at operation that the thrill was considerably lower in the heart than that felt with a ductus. Occlusion of the ductus did not affect the murmur and, although the patient's condition is no worse, it is not improved, and we do not know what the underlying lesion may be. This patient had a normal electrocardiogram and all the radiological evidences of a patent *ductus arteriosus*. The murmur was mainly systolic but contained a definite diastolic element, and in view of the large size of this boy's heart and his obviously unsatisfactory cardiac reserve, we felt that operation was justified; he did, in fact, have a patent ductus. In our first case the ductus was closed with umbilical tape and "Cellophane", the murmur recurred a few days after operation, and this operation must be looked on as a failure. In the second case the ductus was torn and it was necessary to leave clamps on it to control the hæmorrhage; the patient died four days after operation. All the others survived operation, and in all cases, except the one mentioned, in which closure of the ductus did not improve the patient's condition, closure appears to have been successful. Three of the patients were recognized before operation as having some other defect in the heart, probably a patent interventricular septum, and in these three cases, although the machinery murmur disappeared and with it the thrill, a systolic murmur to the left of the sternum in the third space has persisted. Each of the three patients has greatly improved clinically.

We feel that the only associated defects contraindicating closure of a ductus are pulmonary stenosis and other conditions falling within the "cyanotic" group and some cases of coarctation of the aorta. One of our patients was suffering from subacute bacterial endocarditis prior to operation. The infection was controlled with penicillin and the operation undertaken about three weeks after her temperature had become normal; it was conducted without difficulty and the patient has remained well. In another

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case infective endocarditis was suspected, but was never proved by blood culture. The patient was a man of twenty-six years, whose heart was considerably enlarged, and he was showing signs of increasing cardiac disability. His heart outline had returned to normal in three to four months after the operation and he has remained completely well.

Since 1946 we have used the method recommended by Blalock, in which a purse-string of fine silk is placed at each end of the ductus and tied; then two or three running mattress sutures of fine silk are passed through and through the ductus between the purse-strings and tied around it. We do not place an umbilical tape around the closed ductus as Blalock advised, because we think that the large knot lying between the aorta and pulmonary artery may erode the vessels and determine a recurrence.¹

Coarctation of the Aorta.

Crafoord and Nylin reported the first case of aortic coarctation relieved by operation in 1945. This operation was performed by Crafoord in October, 1944, and in July, 1947, he had performed 22 such operations with two deaths and 20 complete successes (quoted from a leading article in *The Lancet*, May 1, 1948). In the 20 successful cases the blood pressure in the upper part of the body fell to or nearly to normal, while that in the legs rose; the circulation was greatly improved and the patients were able to increase their activities very greatly. Gross reported his first case in 1945 and two of his first 21 subjects died.

Only patients suffering from the adult type of coarctation, in which the stenosis is limited in extent and usually situated at about the site where the ductus joins the aorta, are suitable for operation. Coarctation is a serious disease. Crighton Bramwell has shown that patients whose symptoms date from childhood rarely live to the age of thirty years, whereas those who surmount the hazards of the first three decades may suffer little disability from their coarctation. Reinstein, Levine and Gross reviewed a series of 104 cases in which autopsy was carried out, and they conclude that, although coarctation was occasionally compatible with long life, at least 61% of the patients died before or during their fortieth year of life. The average age at death was thirty-five years. Bicuspid aortic valves and congenital intracranial aneurysms are frequently associated conditions and account for many of the early deaths. Special risks that these patients are liable to include: aneurysmal dilatation of the aorta, particularly above the constriction, rupture of the aorta, formation of a dissecting aneurysm, superimposed *Streptococcus viridans* infections, development of high blood pressure in the upper part of the body with all of the dangers of a hypertensive state. Atheroma of the aorta is present in a large proportion of patients with coarctation over the age of twenty-five years, and this of course increases the hazard of operation. For patients with bicuspid aortic valves the risk of subacute bacterial endocarditis would probably not be influenced by surgical treatment of the coarctation, but all the other risks are definitely lessened or eliminated, and even the chance of rupture of a congenital intracranial aneurysm will be less if the blood pressure to the brain is reduced.

The operation is carried out by exposing and isolating the narrowed segment of the aorta and placing clamps across the vessel above and below this segment, and then resecting the segment and restoring the aorta by end-to-end anastomosis. Immediate results are undoubtedly satisfactory, and the 10% mortality reported by Crafoord and Gross must be considered very much less than the normal hazards these patients have to face. It is not impossible that with passage of time some of the transverse aortic scars may stretch with disastrous results. In a few cases in which the nature of the stricture makes it difficult or impossible to carry out the excision with end-to-end anastomosis, it has been possible to ligate the aorta at the site of the stricture and divide it below this ligature, and to ligate and divide the greatly dilated subclavian artery

and bring it down and anastomose its distal end to the proximal end of the descending aorta. Clagett reported one case of successful treatment in this manner and other similar operations have been performed. In view of the hopeless outlook for patients whose symptoms develop in childhood, I believe they should all be offered the chance of relief by operation. For older patients operation may not be indicated unless symptoms are progressive or disabling. We have not yet had the opportunity of operating on a patient with coarctation of the aorta.¹

Pulmonary Stenosis or Atresia.

Although pure or uncomplicated pulmonary stenosis may occur, the majority of patients with this lesion are suffering from the tetralogy of Fallot, in which in addition to the pulmonary stenosis or atresia there is a dextro-position of the aorta with a high ventricular septal defect and a consequent enlargement of the right ventricle. In May, 1945, Blalock reported three patients suffering from this condition in whom he had constructed an artificial *ductus arteriosus* by anastomosing one of the major branches of the aortic arch to a pulmonary artery. Taussig had noticed that patients with Fallot's tetralogy who had in addition a patent *ductus arteriosus* were much less handicapped than patients without this defect. Further she noticed that, as the ductus closed in these babies, they became progressively more dyspnoeic and more cyanosed, and she formed the opinion that the principal factor in their disability was an inadequate flow of blood through the lungs. Blalock's operation increases the volume of blood passing through the pulmonary circulation and strikingly improves the exercise tolerance and the colour of these patients. Blalock has used each of the branches of the aorta and has anastomosed the proximal end of the divided systemic artery into the side of a pulmonary artery or to the distal end of a pulmonary artery which has been divided and ligated. He has found that division of the subclavian artery never seriously affects the nutrition of the limb, but division of the innominate artery or a carotid artery frequently results in cerebral thrombosis with consequent hemiplegia; for this reason, where possible, a subclavian artery should always be selected for the anastomosis. He has found that the best results are achieved when the systemic artery is anastomosed into the side of the selected pulmonary vessel. In July, 1947, he reported his experience with 474 patients (Table I).

TABLE I.

Anastomosis.	Number of Cases.	Number of Deaths.
Subclavian and pulmonary arteries:		
End to side	331	37 (11%)
End to end	23	4
Carotid and pulmonary arteries:		
End to side	30	9
End to end	1	1
Innominate and pulmonary arteries:		
End to side	47	13
End to end	1	1
Aorta and pulmonary arteries: side to side	2	1
Subclavian artery to pulmonary vein (unintentional)	2	2
Exploratory thoracostomy	37	18

On 331 of these he had performed the operation which he considered most satisfactory and had anastomosed the end of a subclavian artery into the side of a pulmonary artery; amongst these patients the mortality was 11%. In 77 patients the same operation was performed, a carotid or the innominate artery being used; amongst these patients the mortality rate was 29%. It is of interest to note that of 37 patients in whom for some reason the operation could not be completed 18 died.

The operation is designed to increase the patient's capacity for exercise, and it is important to realize that some patients with very little cyanosis may be unable to

¹ Since this paper was presented six more ductuses have been successfully closed.

¹ Since this paper was presented one operation has been successfully performed on a girl of twenty.

tolerate any activity without distress. In these patients it will be found that, although the arterial oxygen saturation may be reasonably high while they are at rest, with exercise it falls to a very low level. Polycythæmia is an important factor in the cyanosis, and in some patients a relatively normal blood count will be found to be associated with good colour and an extremely limited exercise capacity. Taussig states that the factors influencing the selection of patients for operation are: (i) the age and size of the patient, (ii) the severity of the anoxia, and (iii) the red blood cell count, hæmoglobin value and hæmatocrit reading. She considers that operation should not be attempted before the age of three years unless the disability is severe and is likely to be fatal before this age. It should be advised for children between the ages of three and ten years with pronounced exercise intolerance and a correspondingly low arterial oxygen saturation.

With a polycythæmia in which there are between eight and ten million red blood cells per cubic millimetre or a hæmatocrit reading between 76% and 80%, the patient is in great danger of cerebral thrombosis and operation should not be delayed. Dehydration by increasing the viscosity of the blood increases the risk of thrombosis, and it is important that it should be avoided before operation and at operation. Blalock has found that in very young babies the subclavian artery is frequently too small to allow a satisfactory anastomosis, and it is in this group that he has had to resort most often to the use of the innominate or a carotid artery with a correspondingly increased mortality rate. As age increases the arteries tend to become more rigid and the gap to be bridged between the divided end of the systemic artery and the pulmonary artery becomes relatively greater, so that it is more difficult to carry out this operation after childhood.

After a successful operation the cyanosis disappears and in many cases the child appears completely normal. Polycythæmia is steadily reduced as the need for it has been removed, arterial oxygen saturation rises from a resting level of less than 50% to between 65% and 88%. As there are always a high interventricular septal defect and an overriding aorta, it cannot be expected that oxygen saturation of the arterial blood will rise to the normal figure of 95% to 98%. Too big an artificial ductus would place an undue strain on the heart. Taussig suggests that an arterial oxygen saturation of 65% to 70% may be sufficient to enable the child to undertake considerable activity and does not necessarily lead to the development of polycythæmia. Although the resting arterial oxygen saturation in these patients may be 70% to 80% or even higher, with exercise it falls considerably and may reach a level of 30% or less. After operation exercise no longer causes a pronounced fall of resting arterial oxygen saturation.

In November, 1946, Willis J. Potts, Sydney Smith and Stanley Gibson described a technique for making a direct anastomosis between the aorta and the left pulmonary artery, using a special clamp they had devised to exclude a segment of the circumference of the aorta to which the anastomosis was to be made, without completely interrupting the flow of blood in this vessel. They reported the histories of three patients on whom this operation had been performed with one death, and in May, 1947, reported a series of 29 operations with four deaths. Some time ago I was informed that Willis Potts had carried out 47 operations with four deaths. Willis Potts's technique has the advantage of avoiding interference with the carotid or innominate artery and thus avoiding the high incidence of cerebral thrombosis which follows Blalock's operation, in which one of these vessels has to be used. The size of the anastomosis in Blalock's operation is determined by the size of the systemic vessel used, and often the surgeon has no choice in this matter. In Willis Potts's operation the size of the opening may be adapted to the needs of the individual, and at the present time Willis Potts aims in most cases at making the slit in the aorta and the pulmonary artery exactly a quarter of an inch in length. It is not yet known whether the artificial *ductus arteriosus* created by either method will enlarge with the growth of the child. If it does not, symptoms may return, as it becomes relatively smaller in relation to the enlarging

arteries. On the other hand, the opening may dilate even to the stage of decompensation, as occurs in some patients with a natural patent *ductus arteriosus*. Time alone will provide the answers to these questions, but because of the many variations which will be found in the vessels of these patients the surgeon who attempts the operation should be prepared to alter his technique when he sees the condition inside the chest.

Blalock's operation should be performed on the side opposite to the aorta, so that the subclavian branch of the innominate artery may be used for the anastomosis. If it is unsuitable, choice remains between the innominate artery and the carotid branch of the innominate. Blalock states that it is easier when the aorta is on the right side, as it is in over 20% of patients with Fallot's tetralogy, because the pulmonary artery on the left side is usually larger than that on the right side. Obviously the Willis Potts operation must be performed on the side on which the aorta is placed, and it too is easier on the left side. My own practice at the present time is to operate always on the left side and to carry out Willis Potts's operation if the aorta is on that side or Blalock's operation if the aorta is on the other side. In my hands the Willis Potts operation has been easier to perform, and for very young infants it would appear to have a real advantage, because it is in these patients that it is often necessary to choose the carotid or the innominate artery to perform Blalock's operation. A right-sided aorta is not so intimately related to the pulmonary artery as is the normal left-sided aorta, and the right pulmonary artery is less suitable for the performance of the Willis Potts operation; it is because both operations are technically easier on the left side that I prefer always to operate on this side. For young infants it may prove better to choose the Willis Potts operation, on whichever side it may need to be performed.

We have operated on eleven children with Fallot's tetralogy and all the operations were performed on the left side. In one patient there was no left pulmonary artery and the operation could not be completed; this patient died some hours after operation. In another the left pulmonary artery was represented by a branch to the upper lobe, and the lower lobe received its blood supply through a large branch of the aorta that ran down and entered the hilum of the lower lobe. The only operation that could have been performed would have been an end-to-end anastomosis between the subclavian artery and the divided pulmonary artery, and we preferred to close the chest with a view to operating later on the opposite side. An anastomosis was performed in nine patients and all of them recovered. In seven the aorta was left-sided and the Willis Potts operation was performed; in two with a right-sided aorta we joined the left subclavian artery, which in both cases arose directly from the aorta to the side of the left pulmonary artery. In the second patient operated on there has been considerable enlargement of the heart, and there are signs that it may not stand up to the strain. This patient was very cyanosed before operation, with a very high degree of polycythæmia and an extremely limited exercise tolerance, and the improvement in her condition has been most dramatic, but we feel that in this patient we may have made too big an anastomotic opening. The other patients have shown very little cardiac enlargement. All of them have shown a great increase in exercise capacity and a complete disappearance or great diminution in their cyanosis and polycythæmia.

Addendum.

Since this paper was presented 27 more patients have been operated on. Of the 39 patients, five proved unsuitable for anastomosis and one of these died. Twenty-three Willis Potts operations have been done with three deaths and 10 Blalock operations with no deaths.

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UNUSUAL PHYSICAL ABILITY AFTER LARYNGECTOMY.

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MANY patients with cancer of the larynx, too advanced for relief by minor procedures, have been denied the chance of cure by laryngectomy because of undue prejudice of the medical profession against this method of treatment, engendered largely by lack of knowledge of modern results. As a result, too many sufferers have been allowed to die without their being offered this possibility of cure.

Certainly in my student days, the mortality from laryngectomy alone was sufficiently appalling to discourage its being advised often. Even those who survived the operation were not taught the mastery of pharyngeal speech and few were fitted with artificial larynxes; so it is no wonder pessimism surrounded this form of treatment, which the years have not dissipated.

Gradually it was found most advantageous that this not-so-common operation be performed by the few fortunate enough to have the experience gained only by performing it numbers of times. So these cases began to gravitate chiefly into the hands of the three surgeons in England, three in America, one in Italy and one in Spain.

As a result of this, the reduction in the mortality rate has been astounding, coming down from 50% to less than 1% in certain hands.

The survivors, even if they did not all actually achieve pharyngeal speech, were cheered by the knowledge that

many of their numbers would speak again. Some even were able to continue as public speakers. The hope that most of them would be able to communicate with their friends by sound bolstered their morale during the immediate post-operative stage, in which formerly suicide frequently terminated the story.

Although many patients so treated have been able to resume the less strenuous of their activities it has been accepted that none can ever again undertake anything but the lightest work, and unfortunately this is generally the case.

That this should be so appears reasonable, for powerful movements of the arms necessitate a fixed thorax for the pectoral and similar muscles to pull upon; but when the patient has no glottis to close, attempted strong arm motions usually result in these muscles expanding the thorax, instead of moving the upper limb.

The two cases of my own described in this article are remarkable in that the patients have overcome this difficulty to such a degree that they have been able to do heavy work.

Case I must be unique from the point of view of the extremely laborious work the patient has been able to continue to do even into old age. Both patients appear to have obtained this remarkable result by overcoming the natural reciprocal innervation of the external and internal intercostal muscles, the former producing the



FIGURE I.

G.C. (Case I) carrying a hardwood log of about 350 pounds weight at the age of seventy-three years, twelve years after laryngectomy, removal of part of pharynx and oesophagus, and dissection of glands of neck.

movement of inspiration and the latter that of expiration. By contraction of both sets of muscles simultaneously the thorax becomes sufficiently firmly fixed to enable the most strenuous of arm movements to be carried out successfully.

Case I.

G.C. was considered to be in an almost hopeless state, for when he presented himself for treatment sixteen years ago, at the age of sixty years, he had an extensive squamous-cell carcinoma of the left pyriform fossa with involvement of the left cervical lymph glands.

On March 15, 1932, I removed his larynx with part of the pharynx and upper part of the oesophagus, and performed double block dissection of the glands of the neck.

At the end of five months, after coaxing with Seidlitz powders, given separately by mouth, he developed a rough, croaky, but loud and perfectly distinct, pharyngeal voice. His speech is interspersed with an extremely short pause for swallowing between phrases, very much shorter than a normal person places between sentences; but as he does not have to cease breathing to speak, he can go on "like the brook" and is, in fact, exceedingly loquacious. How-

ever, increased abdominal peristalsis, such as occurs after taking aperients, causes him to lose his voice, for then he finds he cannot retain air in his stomach long enough to use it for conversational purposes.

His previous employment was cutting hardwood in the bush into railway sleepers, which he carried single-handed and placed on a lorry. Seven months after operation he returned to this laborious trade, stating later that he worked at it harder than ever before.

Twelve years after operation, at the age of seventy-three years, he was still working hard and posed for a photo of himself carrying a ten-foot trunk of solid hardwood, weighing about 350 pounds (see Figure I), a feat few of us could perform in our prime.

He is still alive and enjoying life at the age of seventy-five years.

Case II.

J.P., aged fifty-one years, was a patient with a somewhat better prognosis. I performed laryngectomy on him on December 7, 1943, for an intrinsic squamous-cell carcinoma of the larynx, which had crossed the anterior commissure, recurring after the operation of laryngofissure.

Although an intelligent patient, he proved a disappointment in that he never mastered pharyngeal speech, but persisted in the use of a loud buccal whisper. This he has developed to such a degree that his family and those with whom he comes in contact often, can understand everything he says without repetition, but others vary considerably in understanding what he says.



FIGURE II.

J.P. (Case II) standing beside the cabin cruiser which he commenced to build after laryngectomy and which he launched only eleven months after operation.

Being a building contractor, he gave himself a long "busman's holiday" soon after the operation by laying the keel of a cabin cruiser launch, which he built himself. This boat was actually afloat within eleven months of his operation. Only those who have undertaken boat-building themselves can appreciate the magnitude of this feat (see Figure II).

Returning to his ordinary work he found his difficulty in conversing with strangers a handicap, so he left the interviewing of clients to his son as much as possible; but he has been fully able to occupy his time, making up estimates, supervising work being done, and in fact doing everything else he did in his business previously.

The only sport he has had to give up is swimming, at which he would of course drown. He plays to a golf handicap of 13, and I am assured that he often drives 250 to 300 yards.

Now, three and a half years after operation, he is in good general health and has a most happy and cheerful disposition, giving credit to the operation for the fact that he has never had a cold since it was performed, though he had had many previously.

Reviews.

PHILOSOPHY IN WIT.

DR. EMIL FROESCHELS has written a small book on "Philosophy in Wit" which is certainly unusual.¹ In the first part of the book he discusses the nature of knowledge of philosophical abstractions such as the infinite and the unconscious. His thesis here is that the idea of infinity must be born within us, as we could not elaborate it from the experience of the senses. From this enigma he turns to the unconscious and the subconscious. The former he classes as nonsense; the latter he prefers to call by the ungraceful name of "expression-ripe". This seems to beg the question, but perhaps the medical man with his clinical bent rather remembers the teachings of the British neurologist-philosopher, Hughlings Jackson. The reader, having studied the relationships of "non-expression-ripe" to "expression-ripe", becomes, we hope, expression ripe himself, and enters Part II of the book. This deals with the opinion of other writers on the nature of the comic and jokes. Quoting Bergson's views on the philosophical aspect of wit and laughter, the author points out that few people who laugh at jokes know anything of the philosophy of Bergson, and therefore the capacity for laughter must be congenital.

Perhaps the Phillistine might wonder if the reader in his wish to elucidate laughter is now in the realm of the "non-expression-ripe", but the author tells him sixteen jokes, and explains in philosophical terms why they are funny. Perhaps some readers might prefer *The New Yorker's* version of Number 16, in which the parents of a small boy learning the violin are pleased to learn that he is really making progress, because they fear that they had merely got used to it. All that is amusing in this book is not to be classed as expression-ripe, but a reader with an analytical mind may perhaps learn better how to put in its proper place much of the alleged humour of the entertainment of the screen and the air, and perhaps thereby extend his philosophy from wit to wider aspects of life.

MILK.

IN the preface to "The Better Utilization of Milk" the author, R. C. Hutchinson, states that the book has been written in an endeavour to indicate how milk can be utilized to better advantage and with a minimum of waste.² In this regard it fulfils its function. As a medium for propaganda, it has to be sufficiently general to appeal to readers with widely diverse interests and for the same reason it cannot give details. With one or two exceptions, the author manages to maintain a nice balance.

Dr. Hutchinson, who is an Australian, is well qualified to write upon this subject, for during the last ten years he has served as chemist in a number of Australian firms engaged in the manufacture of milk products and has been a research officer in the dairy section of the Council for Scientific and Industrial Research.

The twelve chapters can be grouped into two sections. The first, comprising chapters one to five, deals with the chemical and physical properties of milk, its industrial components and the effects of temperature and pressure upon the various industrial components. It was, perhaps, his close association with the technology of milk processing that led the author to expand these sections at the possible expense of later portions. The chapter on the effects of temperature and pressure is of limited interest to those outside the industry.

The second half of the book is devoted to the chemical and nutritive aspects of the various individual milk products. In the chapter on whole milk, short notes are given on the various forms in which milk is consumed in differing parts of the world. Thus, the reader learns how the Egyptians, the Bulgars and the Turks treat milk before it is drunk. Considerably more space is given to skim and buttermilk and whey than is usual in publications of this nature. This is in keeping with the author's thesis that more efficient use must be made of the by-products of butter and cheese manufacture if the dairy industry is to be placed on a secure economic basis. Emphasis is given to the wider use

¹ "Philosophy in Wit", by Emil Froeschels; 1948. New York: Philosophical Library. 8½" x 5½", pp. 84. Price: \$2.75.

² "The Better Utilization of Milk", by R. C. Hutchinson, B.Sc. (Tasmania), D.Sc. (Melbourne), F.A.C.I.; 1948. London and Sydney: Angus and Robertson. 8½" x 5½", pp. 234. Price: 25s.

of dried skim milk in processed foods. There are chapters on butter, cream and cheese.

In our opinion the book would have been more valuable to the general public as a source of information on the milk industry if it had contained a chapter or two on the economics of the dairy and milk industries.

The book is intended as a source of reference for those engaged in any one branch of the milk industry and as a stimulant to public thought on the possibilities for the more effective use of milk. It does not, however, go into sufficient detail in any one section to serve as a text-book in any field. Its interest to medical personnel is that it does give a comprehensive review of the nutritive value of milk and milk products, and for that purpose alone it would be a useful addition to the library of practitioners, dietitians and nurses, whose duties call for a full knowledge of milk and milk products.

HUMAN EMBRYOLOGY AND MORPHOLOGY.

SIR ARTHUR KEITH had prepared a sixth edition of his well-known book on embryology and morphology at the beginning of the war, but publication has been delayed until 1948. Meanwhile he has taken every opportunity to bring the work up to date.¹ A review does not provide space for an account of all the changes introduced, but they include the addition of two chapters and a number of new figures, attention to experimental embryology, especially in the matter of organizers, and a general revision of the whole text. Amongst other things, Keith now adopts, with some modification, the Callender-Frazer-Wood Jones view on the development of the upper jaw. He also introduces the Harvey-Burr conception that the pia-arachnoid is derived from the neural crest, but this is a less happy venture since Flexner's later work supports the earlier belief in a mesodermal origin for the leptomeninges. The sections on chromosomes, mitosis and meiosis are rather sketchy and there appears to be no reference to such dynamic factors as fertilization and growth gradients. The points are, however, of little importance in comparison with the excellent standard of the book as a whole, which retains the general logical sequence of its predecessors and provides in the preface a good survey of embryological progress during the past half century.

Fifteen years have elapsed since the last edition appeared, and during that time many generations of students have grown up ignorant of Keith's book. Those of us who can remember the earlier work, however, will welcome this modernized version. There can be very few men today who command the extensive knowledge and accumulated wisdom of Sir Arthur Keith in anatomy, morphology, embryology and anthropology, and it is a source of satisfaction that all this is again available to students of embryology. Incidentally, in view of the author's age, the production of such a work is a great tribute to his perennial youthfulness.

HUMAN HISTOLOGY.

SIMPLICITY AND CLEARNESS are the outstanding characteristics of "Human Histology" by E. R. A. Cooper, a second edition of which has just been published.² The author has been lecturer in histology in the University of Manchester for many years. As its subtitle states, the book is "a guide for medical students", a first book of histology; it is unpretentious and comparatively inexpensive, as such first books should be. In a foreword to the first edition Professor Wood Jones writes: "The book is designed to be a complete guide to the student, and to this end the descriptive text is amply supplemented by illustrations, the vast majority of which are of human material and are actual photomicrographs of typical specimens. The student should regard Dr. Cooper's text-book not only as a manual of human histology that will enable him to become familiar with the subject and so to ensure the passing of examinations, but as a companion to his text-book of pathology when examinations in normal histology are done with."

The opening chapter entitled "The Microscope" forms a sound basis for succeeding descriptions. The section dealing

with blood, marrow and hæmatopoiesis has been rewritten and includes a discussion of varying trends of opinion about the development of the blood cells. One cannot help regretting that colour photography has been used so little in this book. The 257 illustrations include only four coloured plates. Possibly the necessity for economy is the reason for this. However, the average medical student will, after all, do very well indeed if he masters the contents of Dr. Cooper's lucid and practical manual. In our review of the first edition, it was suggested that the use of diagrams in addition to photomicrographs would be helpful. Dr. Cooper refers to this criticism in the preface to this second edition, stating that the omission was intentional as it had been surmised that lecturers in histology illustrated their lectures by means of sketches and the microprojection of the actual sections provided for students. A diagram of the nephron is, however, included in this new edition.

A SUMMARY OF SURGERY.

THE eighth edition of "A Short Practice of Surgery" by Hamilton Bailey and McNeill Love is being published. In order that the material can be kept as up to date as possible the edition is being presented in five parts which will appear at intervals of approximately two months. Parts 1 and 2 have now appeared.¹ Previous criticisms of this book have been levelled at the fact that it is a summary and that a summary is never as good as a complete account. The authors, however, have apparently made up their minds that the book is to remain a summary and therefore it must be criticized at this level.

As has been stated before, the presentation of the material is magnificent. Many of the old photographs have been replaced. The use of type and paragraphing is, as it always has been, most effective. It can be said in short that if a summary of surgery is wanted there is no better summary than this.

SULPHONAMIDE AND ANTIBIOTIC THERAPY.

WITH the many recent developments associated with the sulphonamides and the antibiotics, most doctors need a book upon the subject to enable them to use these drugs most efficiently and such a book is "A-B-C's of Sulfonamide and Antibiotic Therapy" by Perrin H. Long,² who is Professor of Preventive Medicine at the Johns Hopkins University. The practical pharmacology of the various drugs is clearly and concisely discussed and complete instructions are given for the various methods of administration. A very important chapter is devoted to toxic manifestations and their prevention and in particular the author issues a warning against the contact dermatitis which may occur in doctors and nurses from the handling of streptomycin. All the diseases for the treatment of which these drugs are applicable are listed alphabetically for handy reference, and dogmatic instructions as to the specific therapy of each disease are given. All these features make the book most useful, especially for busy general practitioners.

PHYSIOLOGICAL PSYCHOLOGY.

"PHYSIOLOGICAL PSYCHOLOGY" by G. L. Freeman provides a comprehensive survey of those aspects of the physiology of the nervous system that are likely to be of interest to the psychologist and of the experimental work in the same sphere.³

The book is divided into four parts. The first is devoted to basic mechanisms in behaviour, dealing mainly with the various receptor or effector mechanisms. The second part

¹ "A Short Practice of Surgery", by Hamilton Bailey, F.R.C.S. (England), F.A.C.S., F.R.S.E., and R. J. McNeill Love, M.S. (London), F.R.C.S. (England), F.A.C.S., F.I.C.S.; Eighth Edition, Parts I and II, 1948. London: H. K. Lewis and Company, Limited. 8½" x 5", pp. 450, with illustrations, some of them coloured. Price: £2 12s. 6d.

² "A-B-C's of Sulfonamide and Antibiotic Therapy", by Perrin H. Long, M.D., F.R.C.P.; 1948. Philadelphia and London: W. B. Saunders Company. Melbourne: W. Ramsay (Surgical) Proprietary, Limited. 7" x 4", pp. 248. Price: 24s. 6d.

³ "Physiological Psychology", by G. L. Freeman, Ph.D.; 1948. Toronto, New York and London: D. Van Nostrand Company, Incorporated. London: Macmillan and Company, Limited. 9" x 5", pp. 548, with illustrations. Price: 25s.

¹ "Human Embryology and Morphology", by Sir Arthur Keith; Sixth Edition; 1948. London: Edward Arnold and Company. 14" x 5½", pp. 708, with illustrations. Price: 40s.

² "Human Histology: A Guide for Medical Students", by E. R. A. Cooper, M.D., with a foreword by F. Wood Jones, F.R.S., F.R.C.S.; Second Edition; 1948. London: H. K. Lewis and Company, Limited. 8½" x 5½", pp. 446, with illustrations, some coloured. Price: 27s. 6d.

surveys the structure and functions of the various divisions of the nervous system, and is followed by six chapters on the integrative action of bodily mechanisms. Part IV deals with bodily mechanisms, and here the author discusses in particular motivation, learning, fatigue and personality.

The book is likely to be of interest only to the psychologist and the medical psychologist. It rather surprisingly sticks to its last, and makes no incursions into the realm of psychopathology. The medical reader will regret that more attention has not been given to the physiology of emotion. A brief ten pages are devoted to the discussion of this important aspect of the subject—lamentably brief in view of the importance of emotion in psychopathology. The author adopts the dynamotor theory of emotion. According to this, emotional experience is the combination of the primary exteroceptive excitation and the secondary interoceptive excitation aroused by the motor discharge at the thalamic level.

Each chapter is followed by a series of selected references, which together form an adequate bibliography. The book is adequately and clearly illustrated.

TREATMENT IN OBSTETRICS AND GYNÆCOLOGY.

"OBSTETRICS AND GYNÆCOLOGY", by Beatrice Dobbie, bears the subtitle "A Synoptic Guide to Treatment", but is in no sense a synopsis.¹ It is a comprehensive plan of treatment based on well-conceived principles, and as such can be confidently recommended to general practitioners and young specialists as a *va-de-mecum* of high excellence.

In the section on obstetrics, which occupies two-thirds of the book, concise techniques are presented in didactic fashion to fit the normal and abnormal in every phase of the subject, and to the novice confronted with the anxieties of breech delivery, uterine inertia, eclampsia, *et cetera* this should be a valuable aid. Of course, we shall not all agree that a perineal tear heals better than an episiotomy, or that the thumb should be used to deliver the head in the modified Ritgen manoeuvre. Nor will the average Australian practitioner accept the finger as a more ideal instrument than the curette in dealing with an incomplete abortion. But these are details subject to perennial controversy, and in no way detract from the general quality of the book.

Gynæcology is also well presented, the outstanding feature of this section being the commendable effort of the author to foster cancer consciousness and accuracy in diagnosis.

One feels with the author that conscientious adherence to the principles she has prescribed will go far in eliminating the only too frequent mediocrity in obstetrics, and the sham and guess work which so often characterize the practice of gynæcology.

RECENT PROGRESS IN CARDIOLOGY.

It is very pleasing to see a new edition (the fourth) of "Recent Advances in Cardiology" by East and Bain,² as it is twelve years since the previous edition was published and important advances have been made in the interim. The book has been entirely rewritten, but as in former editions it contains not only the newest information in this branch of medicine, but also a survey of older well-established material. This enhances the value of the work, especially to the general physician and the student studying for higher degrees.

The chapter on congenital cardiac defects has been enlarged fourfold and a classification is given based on embryological considerations with good descriptive diagrams. The authors are enthusiastic about ligation of the patent ductus arteriosus, advising it for all patients, preferably between the ages of six and twenty, provided that neither coarctation nor pulmonary stenosis coexists. On the other hand they stress the dangers of the operation for coarctation and also point out that despite the dramatic improvement which may follow operation in cases of pulmonary stenosis of the Fallot type, the heart is still very much deformed and "a still further abnormality is added comparable to the

patent ductus arteriosus; a lesion which surgeons are at pains to remedy in other cases".

Considerable space is devoted to electrocardiography with a discussion of the unipolar leads and a survey of the new theories of electrocardiograms. In discussing the action of digitalis, the authors pay due regard to the work of McMichael and Sharpey-Schaffer, but they consider it premature to jettison Cushney's claim that it causes a stronger cardiac contraction. Scant attention is accorded the newest of the digitalis glucosides, digitoxin, preference being given to the dried leaf and digoxin. The comments on diet both in congestive cardiac failure and in hypertension are conservative and critical. Schemm's régime is considered unpractical and no mention is made of the "rice diet". The use of thioracil in congestive cardiac failure is discussed and the conclusion is reached that in most cases of heart failure a normal thyroid is best left alone. In the section on coronary occlusion a critical appraisal is given of anticoagulant therapy. The chapter on vascular diseases is brief but adequate; no mention is made of the use of tetraethyl ammonium chloride ("Etamon") or of papaverine in these conditions.

In general the subject matter of the book is excellent and the references are well selected and as recent as the latter half of 1947. One can find nothing but praise for most of this work which can confidently be recommended to any physician requiring a sound up-to-date knowledge of cardiology.

Books Received.

[The mention of a book in this column does not imply that no review will appear in a subsequent issue.]

"Psycho-Analysis Today", edited by Sándor Lorand, M.D.; 1948. London: George Allen and Unwin, Limited. 8½" x 5½", pp. 424, with few illustrations. Price: 25s.

A survey by 29 psychiatrists and psychoanalysts depicting the development and progress of psychoanalytical research.

"Practical Orthotics in the Treatment of Squint", by T. Keith Lyle, M.A., M.D., M.Chir. (Cantab.), F.R.C.S. (England), and Sylvia Jackson, S.R.N., D.B.O., with the assistance of Lorna Billingham, D.B.O.; Third Edition; 1949. London: H. K. Lewis and Company, Limited. 9½" x 7½", pp. 288, with 151 illustrations. Price: 35s.

The second edition of this book appeared in 1940; this edition has been largely rewritten to include work done during the last seven years.

"The Surgical Clinics of North America" (issued every two months); 1948. Philadelphia and London: W. B. Saunders Company. Melbourne: W. Ramsay (Surgical) Proprietary, Limited. Philadelphia Number. 9" x 6", pp. 324, with illustrations. Price: £5 5s. (paper binding) and £6 6s. (cloth binding) per clinic year.

Comprises articles in two main groups—a symposium on recent advances in gynæcology and obstetrics, and a symposium on streptomycin in the surgery of tuberculosis.

"Hemolysis and Related Phenomena", by Eric Ponder; 1948. London: J. and A. Churchill, Limited. 9" x 6", pp. 416, with 69 illustrations. Price: 50s.

Deals with the red blood-cell in all its aspects, but is intended to be a "scaffolding for a structure" rather than a compendium or source book.

"Malignant Disease and its Treatment by Radium", by Sir Stanford Cade, K.B.E., C.B., F.R.C.S., M.R.C.P., with a foreword by Sir Ernest Rock Carling, F.R.C.P., F.R.C.S., F.R.C. Volume II: Second Edition; 1949. Bristol: John Wright and Sons, Limited. 9" x 5½", pp. 450, with 204 illustrations. Price: 52s. 6d.

This volume deals with malignant disease of the mouth, pharynx, larynx and neck.

"The National Formulary": 1949. London: The British Medical Association. The Pharmaceutical Society of Great Britain. 6½" x 3½", pp. 130.

This formulary produced by a joint committee of the British Medical Association and the Pharmaceutical Society of Great Britain will be "brought into operation" on May 1, 1949.

"Papers on Psycho-Analysis", by Ernest Jones, M.D., F.R.C.P. (London); Fifth Edition; 1948. London: Baillière, Tindall and Cox. 8½" x 5½", pp. 616. Price: 31s. 6d.

Some changes have been made in the selection of papers included in this edition which the author thinks should be the last.

¹"Obstetrics and Gynæcology: A Synoptic Guide to Treatment", by Beatrice M. Willmott Dobbie, M.A., M.B., F.R.C.S., D.M.R.E.; 1948. London: H. K. Lewis and Company, Limited. 8½" x 5½", pp. 376, with illustrations. Price: 20s.

²"Recent Advances in Cardiology", by Terence East, M.A., D.M., F.R.C.P., and Curtis Bain, M.C., D.M., F.R.C.P.; Fourth Edition; 1948. London: J. and A. Churchill, Limited. 8" x 5½", pp. 464, with many illustrations. Price: 24s.

The Medical Journal of Australia

SATURDAY, APRIL 9, 1949.

All articles submitted for publication in this journal should be typed with double or treble spacing. Carbon copies should not be sent. Authors are requested to avoid the use of abbreviations and not to underline either words or phrases.

References to articles and books should be carefully checked. In a reference the following information should be given without abbreviation: initials of author, surname of author, full title of article, name of journal, volume, full date (month, day and year), number of the first page of the article. If a reference is made to an abstract of a paper, the name of the original journal, together with that of the journal in which the abstract has appeared, should be given with full date in each instance.

Authors who are not accustomed to preparing drawings or photographic prints for reproduction are invited to seek the advice of the Editor.

AGNES HUNT AND HER PLACE IN MEDICINE.

EMERSON once wrote that our chief want in life is somebody who shall make us do what we can. This is particularly true, of course, in the treatment of sick people and finds its most obvious application in orthopaedics. Unless the disabled are encouraged and made to do what they can, they will not recover and their condition is indeed likely to regress. On the other hand, once they are made to do what they can, their range of activity is further increased, and after a shorter or longer time they find that they are doing more than they thought they could ever do again. Nowadays when muscle reeducation, physical exercises and vocational training are recognized as part of the practice of orthopaedics, it is easy to take these things for granted, to forget how they have been brought about and who has been responsible for the happenings.

In the matter of word association most medical graduates, and certainly most surgeons, will agree that the word "Liverpool" comes to mind as soon as the word "orthopaedics" is mentioned, and *vice versa*. The orthopaedic tradition is the Liverpool tradition and the Liverpool tradition is the orthopaedic tradition. With this is associated the name of Robert Jones, whose "Life" by Frederick Watson was published in 1934, in the year after his death. It was of Robert Jones that Lord Dawson of Penn, then President of the Royal College of Physicians of London, said in February, 1933: "Scientific thinker, inventive craftsman, teacher, leader of men, he gave himself and through his disciples great service to mankind." But the story of Robert Jones, told with such clarity and affection by Frederick Watson, tells only in part how orthopaedic surgery came to full fruition after the war of 1914-1918. The figure of Robert Jones dominates the picture, as indeed it should, and two others are mentioned—Hugh Owen Thomas and Agnes Hunt. The history of orthopaedic surgery in Liverpool could not be written without adequate mention of Hugh Owen Thomas, and Watson does him full justice. The work of Agnes Hunt is referred to by him, but she does not receive the recognition that has been granted to her recently by Sir Reginald

Watson-Jones.¹ Dame Agnes Hunt died last year at the age of eighty-one years, and Watson-Jones writes that her death marks the conclusion of an era of British surgery characterized by the work of three great leaders—Hugh Owen Thomas, Robert Jones and Agnes Hunt—the last mentioned "a crippled nurse of good humoured determination". Robert Jones "made acceptable the teaching of Hugh Owen Thomas, whose austere and sometimes harsh criticism made enemies where he should have made friends, and who could not himself gain general acceptance of the surgical principles in which both he and his nephew believed". Watson-Jones asks why Robert Jones was able to succeed where Thomas had failed. He also asks why it was possible for Agnes Hunt to build a great orthopaedic hospital, create a system of after-care clinics, and establish a new principle of training and resettlement of the disabled. Clearly anyone who could do these things is worthy of a place in the history of surgery; but when the doing of this work is associated with and actually a part of the labours in which Thomas and Robert Jones shared, the term "three great leaders" is justified.

Agnes Hunt was born in 1867. She had a connexion with Australia, because her mother, a widow, brought her, when she was sixteen years of age, to Brisbane with some of her other children in the belief that she would make a fortune from raising Angora goats. The mother's belief proved to be ill-founded and she returned to England. Agnes stayed for a while in Tasmania with a brother who had been injured and she returned to England at the age of twenty. When she was ten years old Agnes Hunt suffered from septicæmia and infective arthritis of the hip joint with high fever, sinus formation and a rapid destruction and dislocation of the joint. But within nine months of her illness her bath chair was harnessed to a pony which was raced until the chair overturned, and within twelve months she was playing ice hockey, keeping goal on a home-made sledge. Later on in life she wrote that she had never been allowed to pity herself or to consider herself different; her brothers and sisters had never been made to fetch and carry for her and she had joined in their play. Watson-Jones writes that at this early age Agnes Hunt began her "apprenticeship to crippledness and the great education of pain". She was destined to limp her way through life with stick or crutch; but she had learned a first principle, the joy of life despite disability, and this was to be her great contribution to medicine. "Baschurch", the pioneer convalescent home, was brought into being in a curious way. In 1900 Agnes Hunt's mother, who was growing old and deaf, announced her intention of living with her daughter. This in Agnes Hunt's words was rather a blow, and it seemed that her career of nursing might be ended. But she realized that it might still be possible to live at home and engage in nursing. Baschurch Convalescent Home began with the adaptation of a small and broken-down country house with an estate of not more than three-quarters of an acre. In the words of Watson-Jones—"the drainage was primitive; the garden was so run-riot that it was a jungle and became known as the lion's den; there were a few cow sheds with broken walls and leaking roofs". Soon the accommodation was unequal to the demand and stables and cow sheds were used for sleeping quarters. The sheds were more damp and draughty within than without and open-air treatment was

¹ The Journal of Bone and Joint Surgery, November, 1948.

quickly enforced. It was from this beginning that there "developed and spread throughout Great Britain and the world the ideals of country orthopaedic hospitals, after-care clinics, preventive treatment, and resettlement of the disabled". Watson-Jones writes that in 1948 the vast resources of the Ministry of Health and the Ministry of Labour are engaged in the treatment and the resettlement of nearly one million disabled persons; orthopaedic hospitals and after-care clinics have been established throughout the country; hundreds of orthopaedic surgeons and thousands of orthopaedic nurses, physiotherapists, almoners and resettlement officers are solving the problems of the crippled and disabled. And he ascribes the beginning of all this work to the fact that "mother intended to live with me". Baschurch Convalescent Home, it should be noted, became an orthopaedic hospital. It was known as the Shropshire Orthopaedic Hospital and is now the Robert Jones and Agnes Hunt Orthopaedic Hospital. It was, Watson-Jones writes, in 1927 that Agnes Hunt "succumbed to the stimulation of Robert Jones" and agreed that it was not enough to search out cripples and arrange hospital and after-treatment—cripples had to be taught the responsibilities of normal work. Realizing that a retraining scheme was necessary, she, to use her own words, "collected four boys, already training in the boot and blacksmith's shops, and two girls from the splint-making department, and solemnly informed them that they were. 'The Shropshire Orthopaedic Training School for Cripples'". This was the beginning of the Cripples' Training College, and the four boys and two girls were the "forerunners of a great reform in resettlement of the disabled of which Great Britain is now proud". Watson-Jones is evidently quoting someone else when he refers to Agnes Hunt as the "Florence Nightingale of orthopaedic nursing"; the name seems peculiarly appropriate. She was the recipient of the Royal Red Cross and was created a Dame Commander of the Most Excellent Order of the British Empire. These are the symbols of formal and public recognition of achievement. Important and appropriate though they were, they must take second place to the warmth of the esteem and gratitude which will always be manifest among those who carry on the work which she and the two other "great leaders" started, and among those who in the course of their studies have learned anything about the subject.

Esteem and gratitude are sentiments which should be encouraged, but those who manifest them should go further. Watson-Jones asks why it was that Robert Jones and Agnes Hunt were able to do what they did. He refers to diplomacy and tact and supreme integrity of purpose and to the fact that both of them recognized merit not only in their equals but in their juniors, and once having recognized it, gave encouragement with complete disregard for personal feelings of jealousy. He goes further and declares that they each had a twinkle in the eye, a keen sense of humour, a puckish wit and an almost child-like pleasure in the simple fun of playing pranks. Neither of them thought that dignity was to be sought by rigid discipline of behaviour, yet each achieved supreme dignity. Each of them believed in the joy of life and also believed in showing it—without these infectious qualities their work could never have been done. It does not detract from the accomplishments of the "three leaders" to reflect that the time was ripe and the work was waiting

to be done when they were there to do it—new ground had to be broken, prejudices had to be overcome and adherents had to be found and won. A leader in matters of this kind has to convince those whom he would have as disciples of the soundness of his judgement and the correctness of his opinions. The worker among the disabled is doing grateful work; his work is psychological as well as vocational. In *The Lancet* of November 6, 1948, a medical officer who was severely wounded and lost a limb describes his gradual recovery and how he had to bluff those who were in charge of him that he was able to do more than he really could do. In the end he was able by sheer grit and refusal to be set aside to return to medical duties and take his place alongside other medical officers who had suffered no disability. His story is one of confidence and determination and describes the kind of attitude which Agnes Hunt tried to create. Agnes Hunt was once asked to name the essential qualities of a nurse and defined them as common sense, gentleness, kindness, and the power of giving hope and joy to those who are suffering. This brings us back to Emerson's statement about our chief need. While we honour the names of Hugh Owen Thomas, Robert Jones and Agnes Hunt, we should see to it that we practise what they taught and induce others to do the same. Self-reliance and determination to overcome disability are needed today by an ever-increasing number of people.

Current Comment.

THE VALUE OF AUREOMYCIN IN ENTERIC FEVERS.

A CONSIDERABLE amount of work has been done on one of the new antibiotics, aureomycin, which appears to be of promise in certain bacterial and rickettsial infections, and also in *lymphogranuloma venereum*. Apart from the immense interest shown in any substance which promises to give some control over viral or rickettsial infections, there is naturally a welcome awaiting any improved methods of dealing with the enteric group of fevers. Hygiene has not eliminated typhoid fever, and the *Salmonella* organisms have proved to be of definite potential danger, ranging in clinical effect from passing discomfort to a threat to life. H. S. Collins, T. F. Paine, E. B. Wells and M. Finland¹ have supplemented previous publications on the use of aureomycin by giving a detailed account of twelve patients who were treated with this agent. One of them was a typhoid carrier, who had been responsible for several infections in others, but in this instance hopes were not realized, for even after a month's treatment the organisms could still be isolated from the duodenum. Cholecystectomy was performed, but during a period of biliary drainage and afterwards during convalescence typhoid bacilli could still be isolated. The other patients were in a different category, as they all were acutely ill. They varied in age from fourteen months to eighty years. In all, seven patients with typhoid were treated. One had been treated with penicillin and sulphadiazine, which had not been effective, one was an infant, and two had severe relapses, so that a fairly wide clinical field was covered. The results were not conclusive. One of the relapsing patients appeared to respond promptly and well, and in others the condition had only a short febrile course after the aureomycin was started. Another man had a stormy time in a relapse, with complicating hemorrhage from the bowel, but then seemed to show a distinct improvement as the antibiotic was continued. Collins and his colleagues are cautious in expressing any opinion, and

¹ *Annals of Internal Medicine*, December, 1948.

state that it is difficult to be sure if aureomycin exerted more than some favourable influence. In such a small series, however carefully studied, even the disappearance of symptoms at the end of the second week is not proof of the success of any medication. Three patients were treated for severe *Salmonella* infections. One who had intense abdominal symptoms, with diarrhoea and great prostration after twelve days' fever, began to improve within two days of the beginning of treatment. Another had abdominal symptoms of such severity that laparotomy was performed, though no surgical lesion was found, but died from an infection with *Salmonella newport* four days after beginning treatment with aureomycin. Another fatality occurred from severe *Salmonella choleraesuis* infection, uninfluenced by two antibiotics, for streptomycin was also given in the last four days. The last patient also died, in this instance from septicæmia due to the colon bacillus; it is thought that here the presence of suppurative foci prevented the success of any treatment. In none of these patients was any toxic effect of the drug noticed, with the possible exception of slight drug fever in one patient, but the evidence of this is doubtful. Of course this series is small and uncontrolled, but careful study of these seriously ill people shows that no difficulties were encountered in the use of aureomycin, and it is possible that it was of more value than the caution of the authors indicates. Aureomycin has certain advantages: it is highly stable in the dried form, it is active *in vitro* against many bacteria, including cocci and Gram-negative bacilli, and some organisms resistant to penicillin and streptomycin, and it appears to be clinically effective when given by mouth. The future of this antibiotic will be watched with interest. Perhaps the treatment of the enteric fevers will not prove to be one of its successes, but its non-toxicity and ease of administration encourage further trials.

A NEW MYCOBACTERIAL INFECTION IN MAN.

A MYCOBACTERIUM hitherto unrecorded and pathogenic to man has been recently described in Victoria. It was found in a series of cases of skin ulceration and, though the causal relationship of mycobacterium to ulceration is not fully proved, the direct evidence is very strong. A symposium¹ describing the infection is divided into four parts. The clinical aspects are described by P. MacCallum, who tells of the characteristic lesions in the skin of six patients, five of whom lived in the Bairnsdale district of Victoria. Minor trauma to the limbs was followed by extensive sloughing ulceration, which persisted up to seven months. No chemotherapeutic treatment was of any avail, and excision of the area followed by skin grafting and the use of "elastic resilience" resulted in cure of five patients. There was one fatality, the patient being a three-year-old boy, but the cause of death was not clear. Microscopically the lesion was of an indolent type with macrophages, lymphocytes and plasma cells; when secondary infection took place polymorphonuclear cell infiltration dominated the picture. The use of Ziehl-Neelsen stain showed enormous numbers of acid-fast rods in the lesions, but no tubercle formation. In three cases laboratory investigations were carried out by Jean C. Tolhurst and Glen Buckle. Inoculation of the material onto several media suitable for mycobacteria failed to produce cultures, and common laboratory animals were also inoculated. Guinea-pigs and mice were unaffected, but one rat died after fifteen months, with a local lesion containing acid-fast rods. This was transferred by intraperitoneal inoculation to another rat, then by means of ground lung tissue to a third rat, and the organism was maintained in animal passage, but not cultivated. Rabbits inoculated intraperitoneally developed lesions in the epididymis, and rats also developed lesions on the pads of the feet, the tail and the snout, once a lesion had developed in the scrotum. Cockerels and lizards were not infected. A total of 52 rats showed this clinical picture, and the appearance was not comparable with rat leprosy. The pathology of the lesions was studied in detail by H. R. Sissons, who

described necrosis of fatty tissue and all cellular elements in the epididymis, and the acid-fast rods, abundant in macrophage cells, producing a "foamy" appearance, but not producing the characteristic tubercle. Minute lesions were found over the peritoneal surfaces of liver and spleen, and fibrinous exudate over the peritoneum. There was no spread of infiltration along nerve trunks. The site of the lesion in the epididymis was an outstanding difference from the lesion of rat leprosy. The cultivation of the organism was finally achieved by the use of a temperature of 30° to 33° C. J. C. Tolhurst and Glen Buckle, who were responsible for the cultivation, noticed that the lesions developed on exposed parts—tail, nose *et cetera*—and applied this observation; finally cultures were obtained after four weeks' incubation at the lower temperature on egg yolk agar, and in the most recent case the organism was cultivated direct from the lesion. The colony is faintly pigmented and rough in appearance, and the growth is difficult to emulsify. It is killed by exposure to a temperature of 60° C. for thirty minutes. No serological investigations have yet been completed. The team of investigators believe that they have isolated a mycobacterium which produces an effect hitherto undescribed. At present, until more is known of the origin and transmission of the bacterium, the effect is descriptively referred to as Bairnsdale disease by those engaged in its investigation. No possible vector has been found, and observations are to be continued.

HIGH ALTITUDE HYPOXIA.

INTEREST has been taken for many years in the effects of exposure to the low oxygen tensions associated with high altitudes, but the matter was largely of academic interest only until the development of high-flying planes during the recent war. Just how practical a problem it then became is reflected in the clinical and pathological data that have since come to light. Of particular note is a paper by R. B. Lewis and W. Haymaker² based on the findings at autopsy in 75 cases of death due to high altitude hypoxia. All but two of the deaths in which the altitude was known occurred at 20,000 feet or more and about one-third of them at between 26,000 and 28,000 feet. The tail gunner was by the far the most often affected of the crew members. The actual circumstances of the hypoxia are discussed fully and will be of interest to those directly concerned with the problem; further reference is unnecessary here. At autopsy, evidence of circulatory failure was conspicuous in most cases. Common features were cyanosis of skin or mucous membranes, failure to clot of the blood in the heart and larger vessels, engorgement of systemic veins, congestion of internal organs and oedema of the lungs. Hæmorrhage occurred in various internal organs, most commonly in the lungs; vascular engorgement and hæmorrhages of mastoid cells, middle ear, inner ear, petrosal bone cells and paranasal sinus were common findings. The hæmorrhages generally occurred in tissues which were not compact and which had little physical support, for instance, the thymus gland and the adventitia of the aorta. Another striking feature, which Lewis and Haymaker find difficult to explain, was the presence of intracellular vacuoles with or without inclusions in certain internal organs, especially the heart and liver. The findings of other investigators are discussed, but no clear conclusion is reached. Reactive changes in the leptomeninges and brain were frequently observed, notably in leptomeningeal histiocytes, with extravasation of lymphocytes in perivascular spaces of the brain and acute changes in the brain ganglion cells. Attention is drawn to the remarkable fact that reactive changes took place despite the very brief interval in most cases between the hypoxic accident and death, but no explanation is forthcoming as yet. There is still much to be learnt about the effects of hypoxia and how they come about; Lewis and Haymaker's investigations supply a great deal of detail for consideration and should stimulate further research into this essentially modern problem.

¹ The Journal of Pathology and Bacteriology, January, 1948.

² The Journal of Aviation Medicine, October, 1948.

Abstracts from Medical Literature.

RADIOLOGY.

Osseous Development and the Costal Cartilages.

J. VASTINE, MARY VASTINE AND ORIOL ARANGO (*American Journal of Roentgenology*, February, 1948) state that there are few structures in the human body which have been the source of greater curiosity or more futile conjecture than the costal cartilages. This is probably due to the fact that the chest is the part of the body most frequently submitted to X-ray examination and the bizarre patterns of ossification seen in the costal cartilages are often the most striking feature in the radiograph. Ossification progresses in a cephalo-caudal direction, usually commencing in the first rib. The centre of the cartilage first becomes ossified and later the costal and sternal ends. These areas of ossification begin in the second decade and become more extensive as age advances. Isolated instances of very pronounced ossification at an early age have been observed. The cause or significance of this ossification has never been understood. Attempts have been made to correlate the degree of ossification in the costal cartilages with susceptibility or resistance to tuberculosis, states of nutrition (it is believed by some observers that ossification occurs at an early age in individuals suffering privations), variations in the mineral metabolism, and endocrine dyscrasias. The authors believe that all of these have been erroneous. It was observed that in numerous cases of homozygotic twins, the pattern of the ossification of the costal cartilages was almost exactly the same. This similarity obtained in both the amount of ossification and the arrangement. It is concluded that the pattern taken must be transmitted directly by the genes rather than be subject to any acquired factor or to any metabolic, nutritional or infectious influence. These observations have seemed to establish the genetic influence as the main factor in the ossification of the costal cartilages, to offer an easy criterion to aid in identification of homozygotic twins, and to suggest the pathological insignificance of ossification of the costal cartilages.

Superficial Spreading Carcinoma of the Stomach.

ROSS GOLDEN AND A. P. STOUT (*American Journal of Roentgenology*, February, 1948) state that superficial spreading carcinoma of the stomach grows along the mucosa or in the mucosa and submucosa. Its physical effects on the stomach wall are replacement of the mucosa, radiation of the mucosal folds towards the growth, obliteration of the folds by the growth, widening and stiffening of the folds immediately around the growth, nodule formation on the surface, and ulceration. This type of cancer does not produce a mass. A study of 31 cases has shown that the difficulty in the great majority was not to detect an abnormality on X-ray examination of the stomach, but rather to make sure that cancer was or was not present in an obviously abnormal stomach. Cancer may develop at any time in a patient

who has suffered for years from peptic ulcer or gastritis. To detect these cancers, the examination must be elaborate and painstaking, with fluoroscopy and films in various positions. One must look for and try to understand details of structure and movement of the stomach wall to which too little attention has been paid, for example, the character and shape of the margins of the stomach shadow, the shape of the ulcer crater, the relation of the mucosal folds to the crater. In the presence of peptic ulcer the mucosal folds run into the crater. If cancer develops around the ulcer, the mucosal folds stop at the edge of the cancer. The failure of peristaltic indentations to run up close to the crater is suggestive but not conclusive evidence of cancer. This may be difficult to demonstrate with certainty, because of the disorder of peristalsis so frequently associated with gastritis and antral spasm. Under treatment, the healing crater of the peptic ulcer should diminish in size in all directions, in transverse diameter across the mucosal margin as well as in depth; whereas the cancerous crater may diminish in depth but diminishes little or not at all in transverse diameter.

Heberden's Nodes.

R. M. STECHER AND HARRY HAUSER (*American Journal of Roentgenology*, March, 1948) state that degenerative joint disease involves periarticular soft tissue, tendinous attachments and subchondral marrow spaces as well as the joint cartilage and the immediately underlying bone. Degenerative joint disease is considered to depend primarily upon degeneration, erosion, and finally a wearing-away of joint cartilage, followed secondarily by condensation of bone along what had been the subchondral bone plate and at the edges of the joint where spurs are formed. The earliest observed radiographic change is decrease of joint space indicating loss of cartilage. There is later thickening of the bone of the joint surface, evidence of condensation of the subchondral plate and finally spur formation. There is much distortion of joint surfaces producing serrated or notched surfaces with resultant poor approximation of the opposing joint surfaces. Definite punched-out areas, suggesting ulcerations of the joint surfaces, are seen best in the tangential view at the periphery. Heberden's nodes may start as a fluctuant swelling, a myxomatous subcutaneous cyst or a synovial lesion in the skin, but develop from these to large bony deformities. Radiographs reveal enlargement of the ends of the bones with distortion of joint space and irregularity of the joint surface. Large spurs develop from the attachments of the flexor and the extensor tendons to the terminal phalanx. Such spurs seen only in lateral views have been heretofore largely overlooked. The distal ends of the middle phalanges undergo considerable change of the bony structure with irregularity and a foamy arrangement of the trabeculae.

Retrosternal Infiltration in Malignant Lymphoma.

E. G. FLEISCHNER, C. BERNSTEIN AND B. LEVINE (*Radiology*, September, 1948) state that enlargement of the hilar and mediastinal glands is considered to be the most common manifestation of intrathoracic lymphoma and when

present will facilitate the diagnosis in a given case. In the absence of such lymphadenopathy, but in the presence of some of the other varied manifestations of this group, the routine chest radiograph may be quite confusing, since these lesions may simulate a wide variety of inflammatory and neoplastic pulmonary and mediastinal diseases. In these instances the authors have found the straight lateral view of the chest quite helpful and have been able to distinguish a particular group showing retrosternal infiltration with distinct features as an aid to final diagnosis. The following two types of lesions are noted. (i) A soft-tissue mass, "board-like", of even width, ranging from 0.5 to 2.0 centimetres in thickness, and extending from the level of the diaphragm to the level of the sternoclavicular joint, where it merges with normal soft-tissue structures. It is impossible to determine whether it originates from pleura, subpleural tissue or periosteum, and it apparently represents a lymphomatous mass. (ii) A pad-like mass—or several similar masses giving a lobulated appearance—also from 0.5 to 2.0 centimetres in thickness, convex posteriorly, and arranged with the base toward the sternum. It is quite possible that this second type represents an earlier stage and may develop into the first type by further extension. This lesion may precede any other recognizable changes, particularly those of hilar and posterior mediastinal lymphadenopathy, or may be found in combination with related disease manifestations in the chest. Retrosternal infiltration is often associated with presternal oedema and may precede or be found simultaneously with lymphomatous involvement of the sternum.

X-Ray Diagnosis of Glomus Tumours.

W. H. MATHIS, JUNIOR, AND M. D. SCHULZ (*Radiology*, July, 1948) state that tumours of the subcutaneous neuro-myo-arterial plexus, the glomus body, are uncommon, but are by no means as rare as would be indicated by their relatively late recognition as a histopathological entity. The cutaneous neuro-myo-arterial glomus is a minute specialized body composed of an afferent arteriole, a tortuous arterio-venous anastomosis (the Sucquet-Hoyer canal), a system of collecting veins, and a neuro-vascular reticulum, which regulates the flow of blood through the anastomosis. The whole is surrounded by a dense collagenous capsule which separates it from the dermis in which it lies buried about 0.5 millimetre. It is thought that the function of this body is to serve as a temperature-regulating mechanism, both for the body as a whole and for any individual extremity, by causing the blood-flow, in response to certain stimuli, to be shunted from the capillary bed by way of the arterio-venous anastomosis. Glomi have been described in the exposed parts of all warm-blooded animals. In man, although distributed quite widely over the body surface, they are normally present in largest numbers in the nail beds, the tips of the palmar surfaces of the digits, the thenar and hypothenar eminences, and the soles of the feet. Clinically glomus tumours manifest themselves as painful subcutaneous nodules, arising in the various sites of the glomus bodies, which, when exposed to cold or trauma,

precipitate paroxysms of severe, often incapacitating pain. Solitary occurrence is the rule, although multiple lesions have been reported. When a glomus tumour of appreciable size lies in such a position that it is in contact with bone, especially if it is bound closely to the bone by unyielding surrounding tissues, a pressure-erosion defect may appear in the underlying bone. Such a situation obtains when the tumour arises in a digit tip or beneath the nail. Radiologically the typical appearance is that of a smooth, concave deformity in the dorsum or sides of the distal phalanx, but there may be a punched-out defect in the tuft. The margins of the defect are usually smooth, and while the cortical bone may be eroded, a narrow margin of dense bone is preserved; sometimes the bone underlying the tumour shows eburnation. It has been postulated that the pressure defect in the bone is caused by much the same mechanism as is responsible for bone erosion by an arterial aneurysm. Glomus tumours should not be confused with other tumours such as enchondromas, which arise within bone rather than extending to involve it from without. Glomus tumours are benign, and simple excision effects a cure.

PHYSICAL THERAPY.

Carcinoma of the Breast.

F. M. ALLCHIN and C. W. WILSON (*The British Journal of Radiology*, August, 1948) describe two methods for uniform and adequate irradiation of the breast. The first method (for pre-operative irradiation) is that of the predetermined shape, in which the breast is placed within a "Perspex" triangle with sides measuring 10 by 15 centimetres. The sides are at an angle of 45° to the horizontal, and with the applicator applied to each side of the triangle in turn, and the air spaces filled with bolus, good uniform dosage through the whole area is obtained. If the tumour is in the upper and outer quadrant, the triangle method is usually not suitable, and in these cases treatment is by two opposing fields, which sandwich the affected area. The axillary glands are treated separately by a single field directed into the axilla, or by two opposing fields when abduction of the arm is not possible. The second method is for post-operative irradiation, the aim being to irradiate the whole chest wall on the affected side so as to include the whole of the skin flaps and scar with its lymphatic drainage. Two special applicators are used. One of these provides a 25.0 by 17.5 centimetre field in which the central ray of the beam is 2.5 centimetres from one long side and 15 centimetres from the other. The second applicator has a maximum field of 20 by 20 centimetres, but one diameter may be set at any value less than 20 centimetres by an adjustable lead diaphragm. The technique is based on a "skimming" of the chest wall by two opposing fields (the first applicator). The second applicator is used when the distance between these fields exceeds 18 centimetres, and a certain fraction only of the dose is given, depending on the distance. Stage I lesions are treated by radical amputation and clearing of the axilla, followed by post-operative irradiation. Stage II

lesions are treated by pre-operative irradiation, followed in three weeks by operation. Stage III lesions are treated initially by irradiation; if as a result of this surgery is practicable, a modified operation is performed. For stage IV lesions irradiation is the sole method of treatment. The authors also indicate their methods for treatment for metastases.

Cancer of the Larynx.

MAX CUTLER (*Radiology*, October, 1948) discusses the indications for and limitations of radiotherapy in cancer of the larynx based upon a study of 107 patients treated by radiation at Chicago from 1938 to 1942. He states that early lesions of the cord treated by laryngofissure give between 80% and 85% of cures, laryngectomy in more advanced lesions about 60%. Most of the patients have been treated on the 400 kilovolt apparatus with an estimated dose of 6000r to 6500r on the skin, usually only on one field. The overall time of treatment was eighteen days. The radium bomb was also used. The author's conclusions are that irradiation gives as good a result as laryngofissure in lesions suitable for that operation and, in addition, the voice is better. Laryngofissure gives its best results in lesions limited to the middle or anterior two-thirds of the cord. If the tumour is highly anaplastic (grade IV), laryngofissure is usually considered inadequate. The choice between laryngectomy and radiotherapy may be difficult. The author's present practice is to limit laryngectomy to cases of intrinsic cancer in which there is total fixation of the laryngeal structures and in which there are no general or surgical contraindications to surgical treatment. In borderline cases irradiation may be tried when a patient asks for a chance to be cured by this method, but it is explained that laryngectomy should be performed if it fails. It has been established that correct irradiation does not interfere seriously with subsequent laryngectomy. This applies particularly to the small-field technique. The author's figures are as follows: 35% of five-year cures in 107 consecutive unselected cases of laryngeal carcinoma treated by radiotherapy; in operable cases, beyond cure of laryngofissure, 52% of cures were obtained, and in the inoperable group 20% were obtained.

Hyperthyroidism.

E. M. CHAPMAN, B. N. SKANSE and R. D. EVANS (*Radiology*, October, 1948) state that in 1943 Hertz first tried the treatment of hyperthyroidism using a combination of radioactive iodine and potassium iodide. The authors, continuing this work, felt that a five-point programme must be carried out before a decision was made whether the good effect was due to the iodine, the iodide or the radioactive iodine. These five points were: (i) the use of radioactive iodine alone; (ii) the definition of a single effective dose, the duration of its effect and the pattern of relapse, if any, of thyrotoxicosis; (iii) the production of myxoedema by a single dose; (iv) the observation of histological changes in the gland before and after treatment; (v) observations of the toxic effect of radioactive iodine. Between 1943 and 1947, 65 patients have been treated with I^{131} , having a half-life of twelve hours. Another 65 patients have been treated with I^{131} , having a half-life of eight days. Most of the points have been answered.

Radioactive iodine I^{131} has been used effectively alone in a single retained dose averaging twenty millicuries, and myxoedema has been produced. Histological changes seen in the glands one and two years after treatment consist of fibrosis and regenerative hyperplasia. Recurrence of hyperthyroidism has not been observed up to date. Toxic effects have been nausea, slight swelling, and tenderness of the thyroid for a few days. No later evidence of ill effects has been obtained. Effective doses in the second and fifth months of pregnancy have caused no recognizable changes in the children. Experience with I^{131} , the eight-day isotope, has led to the following findings. (i) In the 41 patients who responded, the dose was 8 to 14 millicuries by mouth or 0.142 millicurie per estimated gramme of thyroid tissue. (ii) Myxoedema has been produced in only four cases. (iii) Toxic effects may be related to an exacerbation of the thyrotoxicosis which sometimes occurs in the first week after treatment. Because of this the authors are now giving preliminary treatment with thiouracil to patients in severely toxic states.

Carcinoma of the Lower Lip.

J. A. DEL REGATO (*Radiology*, October, 1948) states that surgical excision, interstitial and surface radium therapy, and X-ray therapy have all been used with success in treatment of carcinoma of the lower lip. Surgical excision is effective in controlling small lesions, is followed by negligible impairment, and is expeditious. It is also of value for extensive lesions, when a large defect is already present, which may ultimately require plastic surgery for repair. Radium, in the form of moulds, is most successful for small and moderate-sized lesions, but is time-consuming, and results as good can be obtained by other methods. The author does not consider radium implants good treatment and prefers X-ray therapy in the majority of cases. The method followed is to remove all bad teeth and during treatment to protect gums with a lead shield. Most patients are treated on 110 kilovolt apparatus with a filter of one-quarter of a millimetre of copper plus one millimetre of aluminium, and the more extensive lesions on 250 kilovolt apparatus with a filter of one-half millimetre of copper. Treatment is fractionated over periods ranging from eight days in lesions one to two centimetres in diameter up to a maximum of six weeks for large lesions. The total dose in the series varied from 3000r to 7000r (measured in air). With reference to metastases in the cervical glands the author found that of 195 patients only 6.6% had clinically malignant glands on admission to hospital. In the majority of cases the first gland to appear was in the anterior sub-maxillary area. A partial upper-neck dissection is considered to be the method of choice with the radical dissection reserved for a few selected cases. Treatment of metastases by irradiation is not justified unless surgery is not practicable and treatment needs to be intensive. Prophylactic irradiation of the cervical glands or prophylactic dissection of cervical glands is not recommended by the author. He reports three-year survival in 84% of patients presenting no sign of metastases when first examined. When metastases were present on admission to hospital the three-year cure rate fell to 37%.

Special Article.

THE NATIONAL HEALTH SERVICE IN GREAT BRITAIN.

BY OUR ENGLISH REPRESENTATIVE.

In order to fit in with other government proposals, notably the National Insurance Scheme, the National Health Service had to be brought into operation on July 5, 1948. The attitude of the medical profession towards the service had been clarified only a few weeks before this date and on the government side not much more than the scaffolding and some of the foundations were in position. Building has gone on steadily over the last eight months, but it will take years to finish the job, and changes in the blueprint may be forced on the architects. It is not easy, therefore, to give a picture of the present position and the following general remarks must be taken with reserve. The National Health Service can be considered from several aspects.

Acceptance of the Scheme.

Doctors have stood loyally by their promise to do their best to work the Act. At least 20,000 of the estimated number of 21,000 general practitioners have signed on and some 40,000,000 potential patients have their names on doctors' lists. This latter figure is not yet firm, as duplications have taken place, and in some districts the number on doctors' lists exceeds the total inhabitants of the area. Lists are being checked, and it is estimated that 95% to 98% of the population will be in the scheme.

Negotiations.

Negotiations between the Minister and the profession go on steadily. The old Negotiating Committee has been dissolved and its place taken by the two new committees, with differing functions. The General Medical Services Committee presents the case for general practitioners, and the newly formed Joint Committee of Consultants and Specialists represents the consultants and specialists. This Joint Committee consists of 18 members, 11 nominated by the three English colleges and the three Scotch corporations, and six by the Council of the British Medical Association, and is presided over by Sir Lionel Whitby, this year's President of the British Medical Association. Both these committees are autonomous and, while their reports are submitted to the Council of the British Medical Association, no confirmation is needed by that body to make the decisions reached absolute.

Cost of National Health Service.

As was expected, the scheme is more costly to run than was estimated. The main source of income is a Treasury grant which, for the period July, 1948, to March, 1949, was set down at £150m. It is now known that £208m. will be required and a supplementary grant for the necessary £58m. has been passed by the House of Commons. In other words the service is already costing one-third more than was estimated. Some of the main increases are as follows (estimated figure being given first, and the actual cost in parentheses):

Running costs of hospitals	£115m.	(£136m.)
Dental services	£8m.	(£22m.)
Ophthalmic services	£2½m.	(£15m.)
Drug bills	£12m.	(£17m.)

Dental and ophthalmic services have been more freely availed of than was expected, though this increase, in its present proportions, may prove to be only a temporary embarrassment. Many dentists have resigned previous appointments in order to join the National Health Service, where more money can be made, and one local authority has closed fifteen school dental centres as a result. The Minister has now ruled that when a dentist's income reaches £4800 gross per annum he should retain only 50% of his earnings over that figure. In consequence some dentists are closing their surgeries, to the detriment of potential patients, particularly those with urgent conditions, when they reach the weekly proportion of the £4800 figure. The staffing and accommodating of the numerous committees, and the replacement of voluntary workers by paid officials contribute to the increased cost of hospital administration. Spending money that the spender has neither saved nor collected is not conducive to economy. Thus in one Spa area, whose hospital finances were previously managed by a local bank manager as a hobby, and done free of charge, the salary bill alone for the same work is £2000 per annum under

National Health Service. The cost of medicines and appliances has risen and a recent list of "free issues" applied for ranged from antiseptic soaps to wigs. When the new committees learn their jobs and when the central authorities have time to probe their activities more closely, some economies will be brought about, but to offset this an increase in the remuneration of general practitioners, nurses, and other auxiliaries seems inevitable, and, as a leader writer in *The Times* comments, "expansion of the service has hardly begun; when it does there will be heavy bills for new hospital buildings, maternity homes, health centres and clinics, as well as for additional doctors, nurses, midwives, health visitors, home nurses, and others. In matters of medical care normal economic rules do not apply". A medical statistician paints even a darker picture and feels that the yearly bill "when in full operation will not be less than £500m. and that in future years it will rise to an even higher figure . . . it will involve us in national ruin". How to meet this increased cost is a vital question, and three possibilities present themselves: (a) an increase in the weekly contribution or a reduction of benefits, which will not be popular with the patients; (b) doctors are already asking for better pay and any drop in their present remuneration may lead to a crisis; (c) an increased Treasury grant, which the Chancellor will not welcome. Where the State is the sole paymaster financial control rests with the Chancellor of the Exchequer or the Treasurer and not with the Minister of Health. The last mentioned has recently asked regional hospital boards and boards of governors to arrange for a reduction of £9½m. in the estimates of hospital maintenance for 1949-1950.

Remuneration.

The terms of service for consultants and specialists are not yet settled, and what is written here refers exclusively to the general practitioner. It is certain that a number of these doctors are facing financial loss, varying in degree, and are having monetary anxieties added to extra work. The reaction of the individual practitioner varies directly with the location and type of practice. A man in a closely settled industrial area said: "I am working longer hours, seeing more patients, giving less time to each one, and earning a little more; the certificates one has to sign are the curse." A practitioner in a seaside resort, with a large proportion of elderly and retired people among his patients, had a different story to tell: "Before July last I had about 1000 patients and made £2000 a year; the number of my patients remains the same, my expenses have altered very little, and the payments I have received have been at the rate of £750 a year." A doctor in a small country town, with a large panel, but without many private patients, feels he is working harder, has had a considerable rise in his expenses, but is saved by the fact that he does his own dispensing, for which he is paid. A father and son, with an old-established practice, part town and part surrounding district, with some private patients, were "fairly well satisfied with their first two cheques", but intend to revert to doing their own dispensing at the first opportunity. Opinions vary as to the gain or loss on dispensing by the doctor. The majority leave it all to the local chemist. Some men, especially those in rural areas, do their own dispensing and are paid a fixed capitation for each patient on their lists for so doing—the more economically they order medicines, the more profit they make. A smaller number, especially those who have previously employed their own dispensers, elect to be paid like a chemist, and are repaid the cost of the drugs used or appliances ordered plus a dispensing fee—over-prescribing in this group might be a temptation. Letters in the Press, medical and lay, confirm that a proportion of doctors are experiencing financial stringency. Sentences such as "Rural practitioners face bankruptcy under the benefits of the N.H.S.", "Although my income is falling I will not be in penury", and "I will have to change my two children from their present schools to cheaper ones", tell their own tale. It was stated in the House of Commons that each member of a firm of three medical men, working in a seaside resort, with 4000 patients on their lists, after deduction of practice expenses, would receive £416 per annum. At a recent conference a delegate stated that a careful survey of his area showed that 35% of the general practitioners were underpaid. As one rural practitioner put it: "I did not realize how few patients I really had till N.H.S. came in." There is no doubt that some doctors are underpaid, but it is not easy to find out how big this proportion is; naturally more is heard from the unsatisfied than from the satisfied. Areas liable to suffer are those where doctors are too thick on the ground, where men had a good private practice, and very few panel patients, and where the patients are scattered and the distances great.

To understand the present discontent and the steps being taken to remedy it, it is necessary to go back some years. The basis on which the remuneration for general practitioners is calculated is the Spens report, which was accepted as a basis for negotiations by both the Ministry of Health and the British Medical Association. This report recommended that half the profession in general practice, between the ages of forty and fifty, should receive a net income of £1300 a year or over (prewar money basis) and that 10% should receive a net income of at least £2000. The report, which was based on conditions obtaining in 1939, further laid down, that in converting prewar to post-war values of money, consideration should be given to (a) the change in the value of money and also to (b) any increases given to members of other professions; this is known as the "betterment factor". The general practitioner is paid for the main part by a capitation fee for each patient on his list. This fee is arrived at by dividing the amount in what is known as the central pool, after certain adjustments, by the total number of potential patients. So if the central pool as finalized stands at x pounds, and the number of potential patients at y and the doctor has z patients, the

yearly amount he is entitled to is $\frac{x}{y} \times z$; but certain deductions are made which vary slightly in different parts of the country. The sum in the central pool was arrived at in the following way: by examining the budgets of some thousands of doctors a statistician estimated that £28m. was a fair figure for the total prewar general practitioner income. This was not sufficient to comply with the recommendations set out in the Spens report, and another £3m. was added, bringing the total to £31m., which was increased later by 1m. on account of the increase in population. It was agreed between the Ministry and the British Medical Association that a sum of £32m. was sufficient to "implement Spens" under prewar conditions. When considering the position today two difficulties arose. It was found that an increase had taken place in the number of doctors in general practice. The prewar calculations as to the amount of the total general practitioner income were made on a general practitioner strength of 17,900, the number then obtaining. Today there are not less than 20,000 principals in the National Health Service, so that 20,000 men are sharing a pool designed for 17,900, which means a drop in each individual income. The second and more contentious point is the value of the betterment factor. The Minister placed this at 34% (£10½m.), a figure opposed and never accepted by the British Medical Association. After several adjustments and deductions the central pool now stands at £39½m., and on this the present capitation fee is arrived at, a nominal 18s., but in practice something over 15s. "This 18s. capitation fee was a delusion, it was 18s., and then so many things were clipped from it" (Dr. E. A. Gregg, Chairman of the Representative Body). The British Medical Association holds that this figure of £39½m. is too low, as it does not allow for the increased number of general practitioners and contains an inadequate betterment factor. Surveys have been made in various areas comprising all types of practice, and, as a result of the information thus obtained, the General Medical Services Committee has issued a report which it recommends should form the basis of the general practitioner case to put before the Minister. The report recommends (i) the addition of £3½m. to cover the increase in the number of principals and (ii) that the betterment factor should be 70% (£25m.) and not 34% (£10½m.), as at present. After some agreed adjustments the central pool would then stand at £55½m., an increase of £16½m. A fixed amount for mileage is provided and is dealt with separately according to the mileage covered. Following recent representations from the British Medical Association, the Minister has increased this fund from £1m. to £2m. This increase will particularly benefit rural practitioners, especially as mileage is now to be paid for journeys in connexion with maternity work done under the National Health Service. To meet exceptional cases of hardship there is a Special Inducement Fund, which does not form part of the central pool, and it was strange to hear the Secretary of the British Medical Association state a short time ago that not one application for help from this fund had been received at the Central Office; many men regard it as a charity and refuse to apply. Since this statement was made applications are coming in. It is difficult to deal adequately with this subject of remuneration in a brief review, and so the figures, as set out in the Supplement to the *British Medical Journal*, February 19, 1949, page 85, are given. In each case the amount of the original Ministry calculation is given first and the adjusted figure, which in the opinion of the General Medical Services Committee is necessary to meet present-day

requirements, is in parentheses. Figures denote millions of pounds.

Prewar total general practitioner income 28 (28), plus Spens adjustment 3 (3), plus 3% population increase 1 (1), plus addition for increase in principals 0 (3½), plus betterment factor 10½ (25), totals 42½ (60½), adjustment for 95% of population in scheme reduces totals to 40% (57½), less mileage 1½ (2) given final totals 39½ (55½). Increase necessary £16½/13m.

Such then are the general position and the steps proposed to improve it. It must be noted, however, that the total payment made to any practitioner in a year will not be known till the final payment for the year is made. A sum equal to 5% of each quarterly payment, and known as the Contingency Fund, is kept in the Central Pool and is paid with the final cheque for the full year. Superannuation is catered for by a deduction of 6% from the net income of the individual practitioner plus a contribution of 8% made by the Government. This latter sum is regarded as part of the practitioner's income for the purpose of the Spens calculation.

The General Medical Services Committee also points out that the surveys have shown that it is the men with average and less than average lists who have suffered most severely, and to overcome this they propose that the extra £16½m. should be distributed wholly in respect of the first thousand patients on each doctor's list; this would produce a sliding scale and raise the average remuneration for the first thousand to over 35s. per head on each doctor's list. For lists of over 1000 the average remuneration per head for all patients would vary from 27s. 6d. for 2000 patients to 22s. for 4000 patients. The General Medical Services Committee has not overlooked the extra work, medical and non-medical, which now falls on the profession and proposes to examine this later when fuller information is available. A conference of representatives of local medical committees accepted this report in full and approved of the recommendation.

Basic Salary.

To help doctors who, by reason of the situation or type of their practice, would fare badly if payment was confined to a capitation fee only, provision was made in the Act for payment of a basic salary of £300 a year in approved cases. Each doctor applying for the basic salary has to prove entitlement. A certain amount of friction has arisen and some hard words have been said and written as no common test seems to be applied by the various local medical committees who consider the applications. Time and experience will solve this problem, but this is poor consolation to the disappointed applicants at the present time. The basic salary question has given rise to one good story, however. A medical man, not in practice, but holding a scientific post, is reported to have applied to be put on the basic salary list and to have stated in support of his application that he had one patient—his wife. Ingenuity and resource of this nature was ill rewarded by a refusal.

The money for the basic salaries is taken from the sum allocated to the various areas, the amount available for distribution in the form of capitation fee being thus reduced. As an offset the recipient of a basic salary suffers a reduction in his capitation fee. Some men refuse to apply for the basic salary as it would reduce the amount paid to brother practitioners.

Consultants and Specialists.

The monetary stringency is not confined to the general practitioner. Many consultants, especially those not on hospital staffs, are being badly hit as income has dropped but expenses remain high. Consultants are working under a temporary arrangement which has recently been arbitrarily extended till July 4 while negotiations are proceeding. The Ministry has produced a draft scheme, but has allowed it only a very limited circulation, though the Joint Committee of Consultants has pressed for its publication. It has been stated that one proposed term of service for consultants on hospitals allows for termination of appointment by three months' notice on either side. This will be strongly opposed. Both the Joint Committee of Consultants and the General Medical Services Committee have announced their intention of pressing for any final award to be made retrospective to July 5, 1948.

Free Medicine for Private Patients.

There is some doubt whether private patients are legally entitled to get their medicines *et cetera* without payment. Common sense suggests that they should, as the Act lays

down that it is the duty of the Minister to provide free medical services for all. The private patient pays by contribution and by taxes for the right to have his medicines free. The Minister thinks otherwise, and has given as reasons for this opinion that (i) diagnosis, treatment, and provision of drugs must all be regarded as part of one process and/or (ii) that the doctor prescribing would have no responsibility for keeping within the rules laid down to govern prescribing under the *National Health Service Act*. Two suggestions have been made as to how the position may be clarified: (a) the British Medical Association to finance a test case in the courts or (b) the matter to be left and adjusted in the coming Amending Act. The former course is evidently to be followed, for the *British Medical Journal* of March 5 reports that a private patient is suing the Minister of Health in a county court for 3s. 9d., this being the sum he was charged for a prescription given by his doctor, whom he saw as a private patient, and counter-signed by a consultant.

Trades Union.

The British Medical Association cannot turn itself into, or act like, a trades union. This matter has been carefully gone into by a committee following an instruction from the Annual Representative Meeting asking for the formation of some sort of organization for the better protection of the interests of the profession, particularly in connexion with the terms and conditions of service under the *National Health Service Act*. The committee suggests the setting up of a parallel body, to be called the British Medical Guild, in the form of an independent board of trustees with power to organize and finance collective action by the profession and to provide financial compensation for practitioners suffering hardship through participation in such collective action (Dr. Dain, *British Medical Journal*, February 19, 1949, supplement page 87). Policy would continue to be laid down by the Representative Body and such policy would be enforced by the British Medical Guild.

General Conclusions.

The service has been loyally supported by the profession and without many of the permanent extensions promised, except in the way of administration, is costing a good deal more than was estimated. Many general practitioners, and not a few consultants, are suffering financial hardship under the present monetary arrangements. Steps are being taken to remedy this and may lead to (a) modification of the basic salary and (b) a capitation fee on a sliding scale. The temporary arrangement under which consultants and specialists work has been extended until July 4 next; it is intended to press for any improvement in financial terms being made retrospective to July, 1948. Negotiations are proceeding between the Ministry of Health and two committees representing the consultants and general practitioners respectively. A proposal is being examined to form a body parallel with the British Medical Association which would have the privileges and powers of a trades union. Consideration is being given by representatives of the profession to matters to be included in the promised Amending Bill. The prophesied mass resignations from the British Medical Association have not eventuated. It looks as if there will be more plebiscites and on less complicated issues than in the past. The great variation in conditions between, say, a practice in a big industrial city and one in the Highlands of Scotland, accentuates the difficulty in arriving at an equitable flat rate of remuneration for the whole country. All doctors are facing extra work. As one man put it: "If I visit a patient at his home I generally have to see other members of the family. If mother comes to the surgery about herself, she brings the children with her." It is felt that a small "fee for service" would reduce this practice. Most doctors report that they get less exacting demands and more consideration from their old panel patients than from the new entry. Judging from the public Press, patients appear to be fairly well satisfied with the new deal.

Universal Providers.

Requests sent to doctors under the guise of "free medicine" recall the chemist in "Three Men in a Boat", who, when regretting he could not make up a prescription, said: "If I was a co-operative store and family hotel combined I might be able to oblige you. Being only a chemist hampers me." One such request ran as follows: "Will you give H—M—four week certificate, put date Sat. 22, 1949, also will you give him a note for extra coal and a note for shirts, vests and pants."

British Medical Association News.

SCIENTIFIC.

A MEETING of the New South Wales Branch of the British Medical Association was held on October 28, 1948, at the Robert H. Todd Assembly Hall, British Medical Association House, 135 Macquarie Street, Sydney, Dr. J. KEMPSON MADDOX, the President-Elect, in the chair.

Peripheral Vascular Disease.

DR. JOHN TYRER read a paper entitled "The Diagnosis of Arterial Disease of the Limbs" (see page 486).

DR. H. C. BARRY read a paper entitled "Some Orthopaedic Aspects of Peripheral Vascular Disease" (see page 489).

DR. JOHN LOEWENTHAL said that he was interested in Dr. Barry's reference to the work of Professor Telford and Mr. Mottershead in Manchester, as he had just finished a year as assistant director of the Surgical Unit in Manchester and had seen much of this work first hand. A useful classification of the types of diffuse obliterative arteritis had been made by Professor A. M. Boyd, Professor Telford's successor. He divided them up into two groups, juvenile and senile, and each group was subdivided into proximal and distal types. A fifth group—senile diffuse obliterative arteritis—was added. The age limit was thirty-five years for the juvenile group, and in the great mass of cases they fitted clearly into one or other type. The proximal blocks affected mainly the superficial femoral, popliteal, or posterior tibial arteries, and the site and extent of the block could be very clearly shown by arteriography. A most valuable aid was the oscillometer, which, when carefully used, would often practically pin-point the level at which the artery was thrombosed. Proximal juvenile block, in the pure form, was not uncommon, and when this was seen in the early stages it was difficult to give an accurate prognosis. Often a good immediate result from sympathectomy occurred, but the disease progressed either further distally in the same limb, or into the other leg, or into the arms; however, in other cases, after the one episode, the condition appeared to remain static or even to become arrested after sympathectomy. When conducting a follow-up of cases of this type at Saint Bartholomew's Hospital, London, he came across a typical example of the latter group. A junior officer in the army, aged thirty-two years, suffered a classical popliteal artery thrombosis in 1938; lumbar sympathectomy was carried out, his foot became warm and claudication vanished. When seen nine years later he had served actively in the field throughout the war, had risen to the rank of major-general and was symptom-free, and there had been no further manifestations elsewhere of arterial disease.

Dr. Loewenthal went on to say that obliterative arteritis of the most distal type was best seen when the process affected only the digital arteries in the toes and the patient presented with a gangrenous whitlow, the leg and ankle pulses were readily palpable and oscillometry showed full oscillations in the limb. These patients reacted well to sympathectomy and conservative local treatment, but there was usually a progress of the disease proximally. This might happen slowly as one or other of the peripheral pulses was lost, or there might be a sudden jump to the popliteal or superficial femoral arteries. The combination of proximal and distal types invariably meant amputation, and the patient would demand such relief when rest pain became severe. Gangrene of the great toe in such cases was of particularly malign significance. In the presence of proximal and distal disease, below-knee amputations had proved troublesome, and above-knee amputations had been gradually adopted as standard practice. The senile diffuse group was that commonly seen when a progressive arteriosclerotic narrowing of the main vessels had taken place. There oscillometry showed progressive diminution in the oscillations as one proceeded distally; at any stage it could become complicated by a main-vessel thrombosis. Diabetic gangrene fell into two main classes: firstly, that in which the patient had diabetes, but an adequate arterial supply to the limb. The condition was essentially one of infective gangrene, and when the foot was well nourished and there were good oscillations in the leg, sympathectomy and conservative treatment gave excellent results. Even with established osteomyelitis in the metatarsophalangeal joints, the affected digits could be removed, the infected bone and soft tissues excised, and the wound closed. Penicillin given locally and parentally ensured primary union. When a single toe was affected the flexor tendon was often infected and necrotic; local amputation should be combined with

excision of the tendon well back into the foot. Lumbar sympathectomy might be indicated also. The other class was that composed of elderly patients, over sixty years old, in whom senile diabetes was associated with advanced senile diffuse obliterative arteritis. In those cases the lesion was primarily ischaemic, the foot was cold and hypoaesthetic, and the infective element was a secondary feature. Above-knee amputation was usually indicated. Dr. Loewenthal felt that a word of warning was needed about upper-limb arteriography. If "Thorotrast" was used it was safe, though there still existed a prejudice against the use of that drug. The iodine preparations, in either 35% or 70% strength, often caused a severe reaction in the forearm and hand with alarming swelling and pain, which resolved only slowly. Even in the lower limb he had seen, after the intraarterial injection of "Pyelectan" or "Pyeosil", a number of femoral arteries become thrombosed soon after the arteriogram had shown the block to be confined to the popliteal segment.

Dr. C. C. McKellar referred to the much discussed question whether, if an artery was tied off, the vein should also be tied. He quoted the case of a patient who had been in his care when he was in general practice. The medical background to the case was that the patient had first been admitted to the Royal Prince Alfred Hospital in 1935 cyanotic, orthopaedic and oedematous. He had had eleven *paracenteses thoracis* and three *paracenteses abdominis* and was discharged from hospital after three months with a diagnosis of cardiac failure, chronic nephritis, and hypertensive crisis with hemiplegia. However, his hemiplegia must have been temporary, and he lived a useful professional life for thirteen years to the confusion of his several medical attendants. One point which might be of interest was that he received one or two millilitres of "Salyrgan" intravenously almost every two weeks for nine years. Dr. McKellar said that he had been called to see him one night when he had had violent pain in the whole of his right leg for two or three hours. The patient volunteered the information that he got relief by standing up, but, owing to his heart condition, he could not stand for long. Dr. McKellar had found the femoral and *dorsalis pedis* arteries clearly palpable on the sound side and not at all on the affected side. When the patient lay in bed, the limb was white and cold to the knee; when he stood up the colour slowly descended to the foot, taking about five minutes to become a slightly violaceous colour, but his pain was then relieved. When he tired and had to lie down, the pallor more rapidly returned (in about one minute), accompanied by a complaint of pins and needles and finally severe pain. Then he would struggle to his feet again, and this cycle threatened to go on to exhaustion. A *crêpe* bandage applied to the thigh under suitable tension produced congestion in recumbency, together with freedom from pain, and the patient was able to rest. Subsequently he was treated with intermittent venous occlusion and was able to resume his professional duties in about a month, with only occasional pallor of his toes in the evening. The pulsation in the groin became palpable at the end of about two months, and there was no more trouble with the leg until the patient's sudden death some three years later.

Dr. Tyrer asked Dr. Loewenthal whether the patients to whom he had referred as having suffered serious ill effects from the intravascular use of organic iodine contrast media had had preliminary skin tests.

Dr. Loewenthal replied that they had not.

Dr. Tyrer said that Kleinsasser, in 1947, had quoted a review of over 660,000 cases of intravascular administration of organic iodine contrast media and found 26 deaths, representing an incidence of 0.0039%. Kleinsasser recommended the use of a skin sensitivity test before organic iodine contrast media were used intravascularly, and if the specific gravity of the urine was low, the performance of a preliminary renal function test in addition.

Dr. W. L. Calov said that Dr. McKellar's case reminded him of the importance of one feature of the pain in peripheral vascular diseases. He was thinking particularly of diabetics. In an ischaemic foot the pain was likely to be much greater when the foot was elevated. When the foot was dependent, the pain was diminished in the majority of cases. The importance of the point was the distinction between the pain of ischaemia and the pain of inflammation. Dr. Calov then referred to nutritional changes. He said that again he was thinking particularly of diabetics, because the majority of cases of gangrene in the toes and the foot seemed to occur in diabetics. That might be a wrong idea, but it was his impression. It had been his experience with diabetics that when the feet were so affected there was nearly always a history of trauma. The healthy foot could sustain an abrasion or minor cut without much harm. In a diabetic such an injury might be very serious, or it might be serious

in a person with some other obliterative arterial disease. After trauma, the next important thing was infection; Dr. Calov did not think that it had been sufficiently stressed at the meeting. Dr. Loewenthal had mentioned the necessity usually to amputate the limb through the thigh if the great toe was affected. Dr. Calov said that he thought one should consider first whether a great deal of sepsis was present there or not. If the patient had sustained a minor injury or no injury and the toe was gangrenous, and sepsis was absent or slight, then it seemed that fairly extensive vascular degeneration must be present, and the right thing in most such cases would be to amputate the limb through the thigh. If much sepsis was present, it might still be possible to save the foot, even if the head of the metatarsal was involved. Many people attending the diabetic clinic at Sydney Hospital had one or two toes less than they had previously had. In conclusion, Dr. Calov expressed his appreciation of the papers and said that he had learnt something from them.

Dr. R. A. Money said that he came in contact with such patients mainly for the purpose of relieving their pain by appropriate measures. He had one point to add—if the patient got relief when the limb was dependent or by the application of venous compression as by the sphygmomanometer, he could be greatly helped by tying the femoral vein, a measure designed to keep the blood in the limb a little longer. In the testing of such patients, Dr. Money placed much reliance on the reactive hyperaemia test. However, he would not like to keep the limb blanched for five or ten minutes. The patients did not appreciate a period longer than about three minutes, and, on release, a flush to the toes should follow in a few minutes. The oscillometer was a very valuable instrument; the only trouble was that there was only one that he knew of in Sydney, and that had to be borrowed. Finally, Dr. Money said that a measure worth using was the intermittent venous occlusion apparatus; it was simple, it would give considerable relief, and it would help to improve the collateral circulation. It might make a difference when there was doubt as to whether the limb could be saved or not.

Dr. W. D. Sturrock referred to radical changes in the attitude in England. He said that those present had been taught that in gangrene or incipient gangrene the limb should be kept dry. The new idea was that the eschar was a very constricting thing and would interfere with the circulation of the part. Many people were now using *tulle gras*, "Vaseline" gauze or saline packs.

Dr. Maddox, from the chair, thanked Dr. Tyrer and Dr. Barry for their papers. He said that Dr. Barry's paper was of interest in showing how the orthopaedic surgeon could be of help in the problem of peripheral vascular disease. However, not enough medical publicity was given to the treatment of acute arterial occlusion. Those who first examined the patient had no comprehension of the acute urgency of the condition—it was much more urgent than acute appendicitis. It was imperative that such patients should be placed somewhere where they could be at once given a lumbar sympathetic block, papaverine and heparin rather than immediate amputation. The question of prohibiting tobacco smoking had not been introduced by the speakers; it was of great importance in peripheral vascular disease from the physician's point of view. Of even greater value than some of the more complex apparatuses were Buerger's exercises. The question of amputation in peripheral vascular disease, particularly in diabetics, was large. Dr. Maddox said that he had seen many transmetatarsal amputations performed by McKittrick in Joslin's clinic which had given excellent results. If amputation was performed before the gangrene had passed beyond the web of the toes, the limb could be saved. High amputation did not carry a good prognosis; the average life of such patients was only a year and a half, and none wore a prosthesis. The close association of the physician and the orthopaedic surgeon was of vital importance. Dr. Maddox finally proposed a vote of thanks to Dr. Tyrer and Dr. Barry for their papers; this was carried by acclamation.

A MEETING of the New South Wales Branch of the British Medical Association was held on December 2, 1948, at the Saint George Hospital, Kogarah. The meeting took the form of a series of clinical demonstrations by the members of the honorary medical staff of the hospital. Part of this report appeared in the issue of April 2, 1949.

Reconstructive Surgery.

Dr. B. W. B. Riley presented a group of patients to illustrate the results of reconstructive surgery. The first patient was a male, aged forty-one years, whose left hand

had been seriously damaged by machinery in April, 1948, with a resultant loss of an area of soft tissue four inches square on the palmar surface of the hand and fingers, leading to gross flexion deformity. Reconstruction was carried out in September, 1948, by means of an abdominal tubed pedicle. The procedure required three operations over a period of ten weeks. Though there was as yet little evidence of the establishment of sensation, the fingers were already approaching a full degree of function. The advisability of raising such a tubed pedicle at the time of the accident, in preparation for the ultimate reconstruction, was stressed.

The second patient, a male, aged eighteen years, provided an example of the characteristic short upper lip and columella, with a resultant "beaked" nose following primary repair of a hare-lip in childhood. Dr. Riley explained that the upper lip had been lengthened by an Abbé technique and the columella lengthened by a VY advancement, the alar openings being narrowed by Z plastic procedures. Those operations enabled a suitably made prosthesis to be employed to build out the previously flat upper lip.

A male patient, aged twenty-four years, had sustained a compound fracture of the tibia and fibula with extensive soft tissue loss on September 10, 1946. In spite of the attainment of good bony union, there remained along the anterior surface of the leg an unstable, adherent scar, in the centre of which was an ulcerated area exposing the tibia. The scar was excised on August 14, 1947, and the resulting defects were closed by a sliding flap brought from the lateral side and based distally. The secondary defect was covered by a split skin graft. Emphasis was laid on the advisability of repairing the soft tissue loss at the time of reduction of the fracture or as soon after as possible, so that a long period of disability and months of futile dressings were saved.

A male patient, aged twenty-one years, had sustained extensive facial burns in 1944, caused by the bursting of a drum containing sulphuric acid, resulting in disfiguring scars and extensive discoloration of the skin. Dr. Riley said that he was presenting this patient to illustrate the technique of sectional excision of multiple scars, use being made of the intervening areas of normal skin. The chin was reconstructed from a tubed pedicle raised from the neck and extending from the angle of the left mandible to a point approximately one inch to the right of the mid-line. He said that such cervical pedicles usually, as in the case under discussion, gave a good result in relation to colour match and texture.

A female patient, aged twenty-three years, had sustained a partial amputation of the left hand, including loss of the hypothenar area, the fourth and fifth digits in their entirety, and the terminal segment of the third digit. An abdominal tubed pedicle measuring six inches by two and a half inches was raised, the proximal end transferred to the hypothenar region, and the distal end later inserted into the amputation stump of the third digit. Dr. Riley said that, as the patient was mainly concerned with the cosmetic aspect, an attempt would be made later to reconstruct the two missing fingers with iliac bone grafts.

Urgent Gastrectomy.

Dr. T. E. WILSON presented a male patient, aged sixty-four years, who for twenty years had had symptoms of a duodenal ulcer, for which he had received treatment. Two years before his admission to hospital he had been told that he had a pyloric obstruction, but he had received only medical treatment. During the four weeks prior to his admission to hospital he had complained of more severe epigastric pain and vomiting. The pain had suddenly become particularly severe and constant three hours before his admission to hospital. On examination the patient appeared thin, and presented the typical picture of a perforated peptic ulcer. At operation a hard, indurated mass about an inch in diameter was found on the anterior aspect of the pylorus, and in the centre of this mass a small perforation was present. The stomach was very dilated, and there was considerable stenosis of the pylorus. On macroscopic examination it was not possible to be certain that the mass was not malignant, although in view of the history that was not considered likely. Because of the presence of the mass and the possibility of its being malignant, and because of the pyloric obstruction occurring in a patient who was in good condition, it was decided to perform a partial gastrectomy immediately. The type of operation employed was an ante-colic Polya procedure with a Hoffmeister valve, with a long afferent loop, and with the afferent loop attached to the lesser curvature. Convalescence was uneventful, and the patient was sent home with the wound firmly healed and symptom-free on the sixteenth day after operation. Since then he had been very

well and had had no symptoms except some epigastric discomfort after eating beetroot. The report of the pathologist on the specimen removed was as follows:

A stomach with pylorus and about $\frac{1}{4}$ " of the first part of the duodenum. There is a perforating ulcer over the pylorus. The ulcer is funnel shaped with an irregular indurated margin on its mucosal aspect and a small circular orifice 2 millimetres in diameter on its peritoneal aspect. There is no macroscopic evidence of malignancy. Two pieces of ulcer wall in section.

Microscopic examination of sections showed the lesion to be a chronic peptic ulcer. No evidence of malignancy was seen.

Carcinoma of the Colon.

Dr. Wilson's next patient was a married woman, aged thirty-two years, who for many years had suffered from flatulence and constipation, but for the most part had enjoyed fairly good health. There was no history of the passage of blood or mucus in the faeces. During the five days prior to her admission to hospital on August 7, 1948, she had suffered from absolute constipation despite two enemata, and for two days had had colicky abdominal pains, nausea and loss of appetite. On examination of the patient her general condition was good, but there was no doubt of the existence of acute intestinal obstruction, probably in the colon, though there was little to indicate its aetiology. At operation a ring carcinoma of the sigmoid colon was found, giving rise to complete obstruction; no metastases were detected in the liver, peritoneum or regional lymph glands. A Paul-Mikulicz type of excision of the sigmoid colon was performed, and the spur was sutured for about four inches. Convalescence was uneventful. A colostomy opening was satisfactorily established. On September 15 a routine extraperitoneal closure of the colostomy was performed. The wound healed by first intention; and she was discharged from hospital on September 26 with her bowels functioning regularly. Since then she had been very well. Microscopic examination revealed that the growth was an adenocarcinoma; a lymph gland located in the mesosigmoid was found to be involved in the malignant process.

Recto-Sigmoidectomy for Rectal Prolapse.

Dr. Wilson then presented a woman, aged seventy-three years, who for several months had complained of increasing prolapse of the rectum and leakage of mucus and faeces from the anus. The prolapse was easily brought on by coughing, straining or defaecation. She also complained of increasing tiredness, weakness and dyspnoea on exertion. On examination she was a thin, frail old woman, with irregular heart sounds, a systolic murmur at all areas of the heart and high-pitched rhonchi throughout both lungs. There was complete rectal prolapse about six inches long, with poor tone in the anal sphincters. Recto-sigmoidectomy was performed under cyclopropane, oxygen and ether anaesthesia, seventeen inches of bowel being removed. The patient stood the operation very well. Convalescence was somewhat delayed because of partial separation of the suture line. That, however, Dr. Wilson considered to be no great disadvantage, as, in fact, the resulting fibrosis helped to fix the rectum and to prevent recurrence. At the time of the meeting the lumen of the bowel was quite adequate, and there had been considerable improvement in control over the bowel compared with the condition before operation.

Adenoma of the Sigmoid Colon and Diverticulitis.

Dr. Wilson's last patient was a woman, aged seventy-one years, who for three years had had pain in the left iliac fossa and had passed small amounts of dark blood with the faeces. A diagnosis of diverticulitis had been made, and enemata and paraffin had produced some relief of the pain, although the haemorrhage continued. On examination of the patient, her colour and general condition were good. Tenderness was present in the left iliac fossa. On sigmoidoscopic examination, eighteen centimetres from the anal margin a red, friable, pedunculated tumour half an inch in diameter was seen, and a small portion was taken for examination. It was found to consist of tubular glands separated by a thin fibro-vascular stroma infiltrated with inflammatory cells. The appearance was consistent with that of a rectal papilloma. In some places the glandular epithelium was somewhat hyperplastic and darkly staining, but there was no definite evidence of malignancy. On X-ray examination a barium enema was seen to flow freely to the sphincter without evidence of obstruction or filling defect. A number of diverticula were seen in the distal part of the sigmoid colon, which had the irregular saw-tooth outline usually associated with diverticulitis.

Inflammatory Lesion of the Penis Simulating Carcinoma.

Dr. C. H. HORSLEY presented a male patient, who had suffered from diabetes for ten years. An ulceration on the prepuce, present for two months, had not responded to treatment with ointments. A dorsal slit operation was performed, and a biopsy obtained of the ulcerated tissue, which was thought to be either granulation or neoplastic tissue. The affected area was later removed, and repair was effected by means of a plastic flap.

Osteomyelitis of the Femur and Pyæmic Abscesses in the Lungs.

Dr. Horsley's next patient was a boy, aged six years, who had been admitted to hospital with pain in the right knee present for four days and abdominal pain of one day's duration. The knee was inflamed and painful, and there were dulness to percussion and bronchial breathing at the bases of both lungs. On the day after his admission to hospital, swelling and tenderness were present, maximal about the lower end of the femur rather than at the knee joint. The knee joint was aspirated, but no pus was obtained, and two days later the lower end of the femur was trephined and an abscess drained, penicillin being instilled into the drainage tubes. A pure culture of *Staphylococcus aureus* was grown from the pus. The patient made a gradual recovery, apart from temporary exacerbations. Altogether 25,000,000 units of penicillin were injected.

(To be continued.)

Correspondence.

THE BRITISH MEDICAL ASSOCIATION IN AUSTRALIA AND ITS MEMBERS.

SIR: Although I believe the Federal and State Councils of the British Medical Association do represent the views of the majority of members on the free medicine and national health plans, the constitution and method of election do not ensure this automatically.

It can very easily be shown that a decision of delegates from local groups does not necessarily represent the viewpoint of the majority, unless it is a unanimous decision, and, of course, a unanimous decision of delegates does not mean a unanimous decision of members. Accordingly in any important matters, such as the above, the views of the members should be determined, from time to time, by a plebiscite, as was done in England.

The method of election practised by the Victorian Branch—striking out a specified number of names from the list of candidates—can have very bizarre results and can even result in the vote being of no effect.

To illustrate this, suppose there are three candidates, A, B and C, two to be elected. A is very well known and certain to be elected, so the real contest is between B and C. A voter may be very anxious to see B elected, and, as he thinks "new blood" is desirable, votes for B and C. His vote is valueless as it does not discriminate between these two. He should have voted for B, whom he does want, and A, whom he does not want.

This is not a theoretical objection; I have seen it happen in a municipal election. Proportional representation is the ideal, but even ordinary preferential voting would be better than the present too simple method. Until some change is made, we can hardly dispute Dr. Turnbull's contention that the Association is not a democratic body.

Yours, etc.,
JOHN R. ELEY.

Beulah,
Victoria,
February 26, 1949.

AN UNUSUAL SYNDROME.

SIR: During the past few weeks there have been seen in Bathurst, by myself and other practitioners, an increasing number of examples of a symptom-complex remarkable for its constancy and quite unusual in our experience. Sufficient cases have occurred to make it clear that we are observing an outbreak of a disease probably identical with that described by various authors under the name of epidemic diaphragmatic pleurodynia, Bornholm disease, devil's grip

et cetera. So far the incidence has been sporadic, and adolescents and young adults of both sexes are the usual victims. All present with substantially the same complaint, that of pain, moderate to severe in intensity and sudden in onset. This is felt either in the epigastrium or immediately below the costal margin, and in the latter case most often on the right side; there have, however, been instances of left-sided or bilateral upper abdominal pain. Some cases experience pain and tenderness over the lower thorax as well. There is usually some fever and often headache; respiratory symptoms are slight or absent, and nausea or vomiting is transient and occurs in some cases only. Respiratory movements are restricted by pain, coughing or sneezing causes great distress, and several patients have had pain referred to the region of the upper border of the trapezius.

Tenderness and rigidity are present over the upper abdomen, but there are no signs at the lung bases apart from those of diminished respiratory excursion, and no friction rub has yet been heard. There is no stiffness of neck or back.

The acute phase is usually passed in two or three days, and all pain goes in a few days more, but whether the comparatively few cases so far followed will set the standard remains yet to be seen. It has seemed wise to keep patients at rest for several days after the disappearance of all symptoms.

It will be most interesting to hear if this syndrome has appeared elsewhere recently. It would seem to be quite common in other countries, particularly in the United States of America and in northern Europe, whence many reports have come. It is presumably due to an infection by a filterable virus having a peculiarly selective affinity for the diaphragm or diaphragmatic pleura, or perhaps for the nerve supply of these structures. In this latter case it would appear to possess the additional ability to select the diverse segmental innervation of the central and peripheral diaphragm to the apparent exclusion of all else, at least so far as the overt manifestations of its presence are concerned.

My personal experience so far is of thirteen cases, and as that of the other men in the town would bring the total to over forty, I feel that we have seen enough to warrant a preliminary report. As a final conjecture, it may be that the presence of large numbers of displaced persons from northern Europe in the area is of significance, particularly if similar cases are not being seen in other centres. I am told by the Migrant Centre medical staff that the syndrome has appeared among their patients, though not in great numbers.

Yours, etc.,
R. E. B. CAMERON.

142 William Street,
Bathurst,
New South Wales.
March 9, 1949.

POST-GRADUATE FACILITIES AT SYDNEY HOSPITAL.

SIR: I am requested by the Committee for Post-Graduate Affairs of the Honorary Medical Staff to inform you that a programme of sessions has been developed in this hospital during the past eight months, which it is now proposed to make available to visitors. These sessions are essentially discussions among members of the honorary staff on selected material or the work of special clinics on a consultative basis; they include medical grand rounds, weekly; medical ward rounds, weekly; medical out-patient clinics, weekly; chest clinic, monthly; diabetic clinic, monthly; haematology clinic, fortnightly; cardiographic staff conference, weekly; neurological and neurosurgical clinic, monthly; surgical grand rounds, weekly; surgical operations, daily; rectal clinic, weekly; varicose vein clinic, bi-weekly; fracture clinic, daily; gynaecological staff conference, fortnightly; urological staff conference, fortnightly; dermatology staff conference, monthly; ear, nose and throat staff conference, monthly; orthopaedic staff conference, fortnightly; psychiatric staff conference, monthly; radiotherapeutic staff conference, monthly; clinico-pathological staff conference, weekly; autopsy reviews, bi-weekly; biopsies of the week, weekly; seminars, monthly.

The full programme, published quarterly, may be obtained on request, and a weekly bulletin is also issued to cover occasional alterations and additions. Admission is by card, obtainable at my office, which also includes the use of the hospital library.

Yours, etc.,

Sydney Hospital,
Sydney,
March 31, 1949.
NORMAN ROSE,
Medical Superintendent.

University Intelligence.

THE UNIVERSITY OF MELBOURNE.

Graduates' Week, 1949.

BETWEEN a university and the body of its alumni there exists a bond whose strength is to be measured not by mere numbers, but rather by the active interest and sympathy which her former children feel in her progress and her difficulties.

With the erection of the Union House in 1938, the University of Melbourne came to possess, as well as a centre for all the manifold activities of the student body, a home within which its graduates could enjoy expression of those mutual interests which university men have in whatever field they practise their chosen professions.

During May of this year the Graduates' Section of the Melbourne University Union will present for the first time a series of activities known as Graduates' Week. The programme for Graduates' Week will be sent to some ten thousand graduates in Victoria during the month of April, and all are urged to take this opportunity of renewing in some way an acquaintance, however dim it may now seem, with their Alma Mater.

Highlights of the programme will be a university banquet to be held in the Buffet Room of the Union House, an exhibition of current research activities in a number of the scientific departments of the university, and a sports day to be held on the university oval. Other sections of the programme will include the presentation of a play by the Tin Alley Players in the Union Theatre, a public discussion of some of the major problems facing the university in the Victorian community, and an evening of documentary films produced by members of the university staff.

All graduates and former students are invited to take some part in Graduates' Week, which is to be held from May 21 to 28, 1949.

The Royal Australasian College of Physicians.

SIMS COMMONWEALTH TRAVELLING PROFESSOR, 1949.

PROFESSOR G. W. PICKERING, Sims Commonwealth Travelling Professor for 1949, will deliver the following lectures in the Verco Theatre at the Institute of Medical and Veterinary Science, Adelaide, at 8.30 p.m.: Thursday, April 21, 1949: "Pain" (Lecture 1); Thursday, April 28, 1949: "Pain" (Lecture 2).

Professor Pickering will deliver the following lectures in the Shell Theatre, Shell House, Saint George's Terrace, Perth, at 8.15 p.m.: Tuesday, May 3, 1949: "Angina Pectoris and Intermittent Claudication"; Thursday, May 5, 1949: "Peptic Ulcer".

Australian Medical Board Proceedings.

TASMANIA.

THE undermentioned has been registered, pursuant to the provisions of the *Medical Act*, 1918, of Tasmania, as a duly qualified medical practitioner:

Fenwick, Clennell Cooke, M.B., B.S., 1923 (Univ. Durham), Ouse, Tasmania.

Nominations and Elections.

THE undermentioned have applied for election as members of the New South Wales Branch of the British Medical Association:

Backner, Daniel Douglas, M.B., B.S., 1947 (Univ. Sydney), c.o. 12 Elva Avenue, Killara.
Poyzer, Kenneth George, M.B., B.S., 1948 (Univ. Sydney), Royal Prince Alfred Hospital, Camperdown.

Medical Appointments.

Dr. E. A. Sanbrook has been appointed Medical Officer, Division of Mental Hygiene, Department of Public Health, Sydney.

Diary for the Month.

- APRIL 12.—New South Wales Branch, B.M.A.: Executive and Finance Committee.
APRIL 12.—New South Wales Branch, B.M.A.: Organization and Science Committee.
APRIL 14.—Victorian Branch, B.M.A.: Organization Subcommittee.
APRIL 18.—Victorian Branch, B.M.A.: Finance, House and Library Subcommittee.
APRIL 19.—New South Wales Branch, B.M.A.: Medical Politics Committee.
APRIL 20.—Western Australian Branch, B.M.A.: General Meeting.

Medical Appointments: Important Notice.

MEDICAL PRACTITIONERS are requested not to apply for any appointment mentioned below without having first communicated with the Honorary Secretary of the Branch concerned, or with the Medical Secretary of the British Medical Association, Tavistock Square, London, W.C.1.

New South Wales Branch (Honorary Secretary, 135 Macquarie Street, Sydney): Ashfield and District United Friendly Societies' Dispensary; Balmain United Friendly Societies' Dispensary; Leichhardt and Petersham United Friendly Societies' Dispensary; Manchester United Medical and Dispensing Institute, Oxford Street, Sydney; North Sydney Friendly Societies' Dispensary Limited; People's Prudential Assurance Company Limited; Phoenix Mutual Provident Society.

Victorian Branch (Honorary Secretary, Medical Society Hall, East Melbourne): Associated Medical Services Limited; all Institutes or Medical Dispensaries; Australian Prudential Association, Proprietary, Limited; Federated Mutual Medical Benefit Society; Mutual National Provident Club; National Provident Association; Hospital or other appointments outside Victoria.

Queensland Branch (Honorary Secretary, B.M.A. House, 225 Wickham Terrace, Brisbane, B.17): Brisbane Associated Friendly Societies' Medical Institute; Bundaberg Medical Institute. Members accepting LODGE appointments and those desiring to accept appointments to any COUNTRY HOSPITAL or position outside Australia are advised, in their own interests, to submit a copy of their Agreement to the Council before signing.

South Australian Branch (Honorary Secretary, 178 North Terrace, Adelaide): All Lodge appointments in South Australia; all Contract Practice appointments in South Australia.

Western Australian Branch (Honorary Secretary, 205 Saint George's Terrace, Perth): Wiluna Hospital; all Contract Practice appointments in Western Australia. All government appointments with the exception of those of the Department of Public Health.

Editorial Notices.

MANUSCRIPTS forwarded to the office of this journal cannot under any circumstances be returned. Original articles forwarded for publication are understood to be offered to THE MEDICAL JOURNAL OF AUSTRALIA alone, unless the contrary be stated.

All communications should be addressed to the Editor, THE MEDICAL JOURNAL OF AUSTRALIA, The Printing House, Seamer Street, Glebe, New South Wales. (Telephones: MW 2651-2.)

Members and subscribers are requested to notify the Manager, THE MEDICAL JOURNAL OF AUSTRALIA, Seamer Street, Glebe, New South Wales, without delay, of any irregularity in the delivery of this journal. The management cannot accept any responsibility or recognize any claim arising out of non-receipt of journals unless such notification is received within one month.

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